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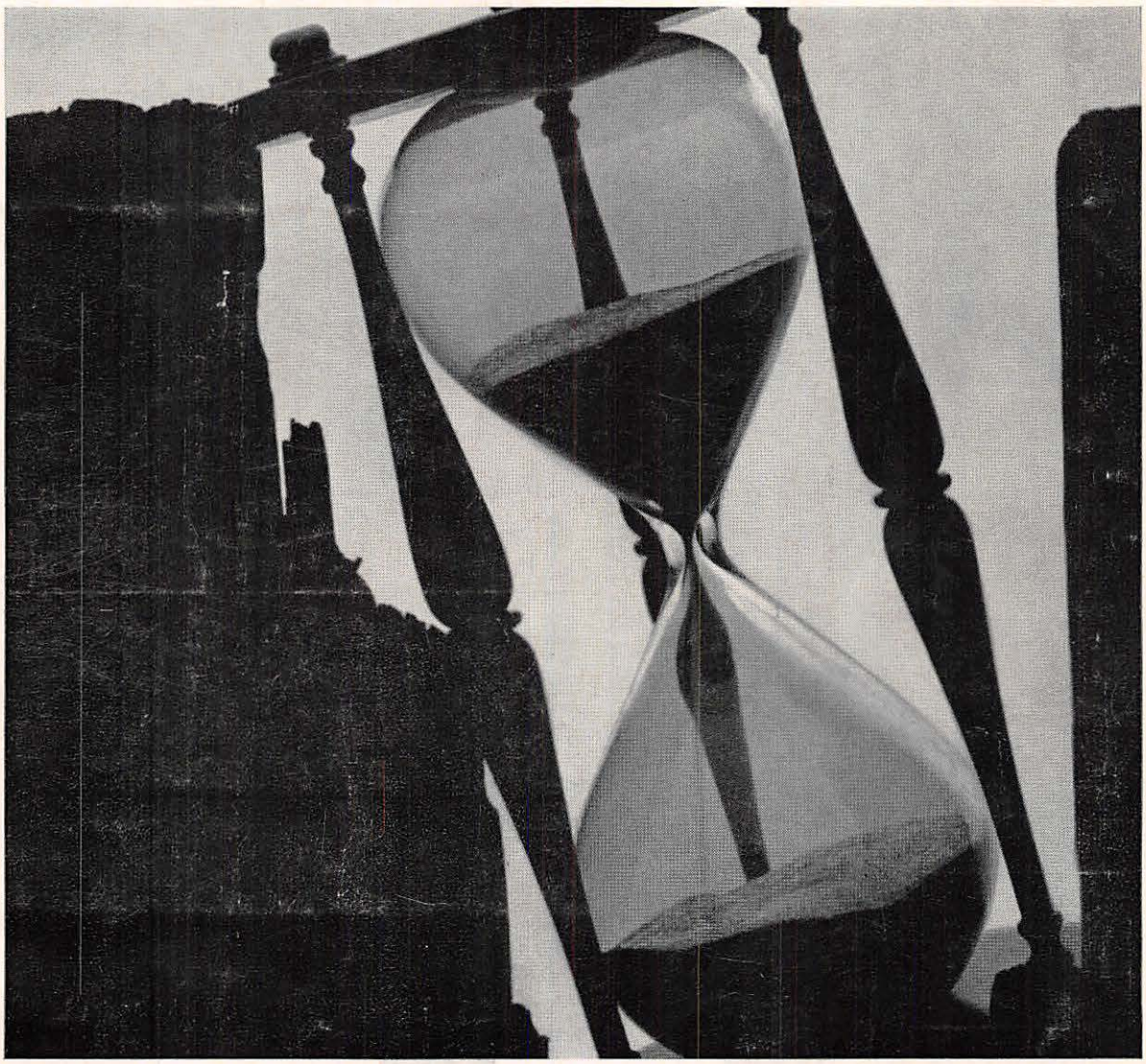

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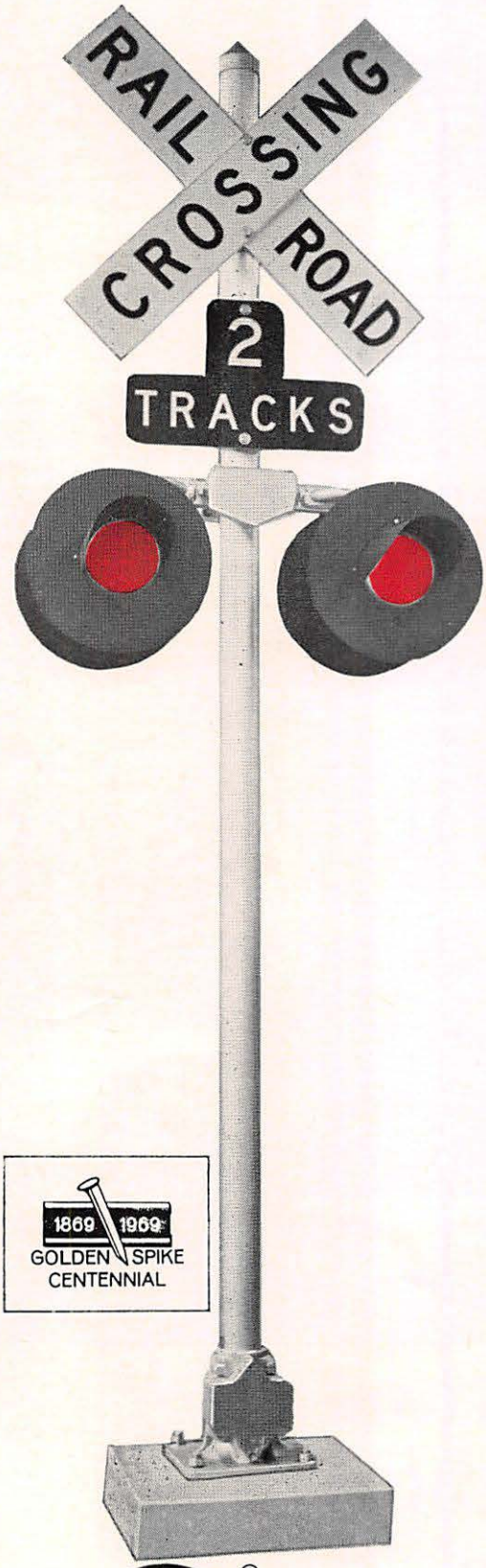

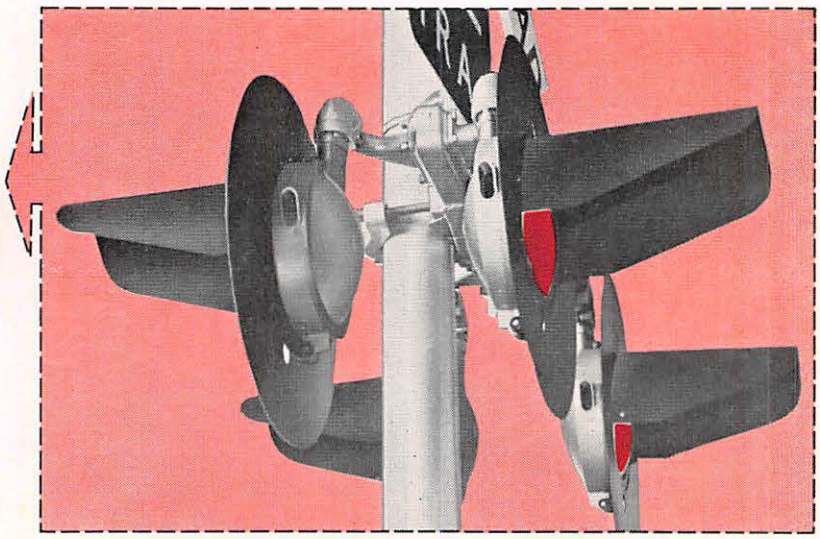

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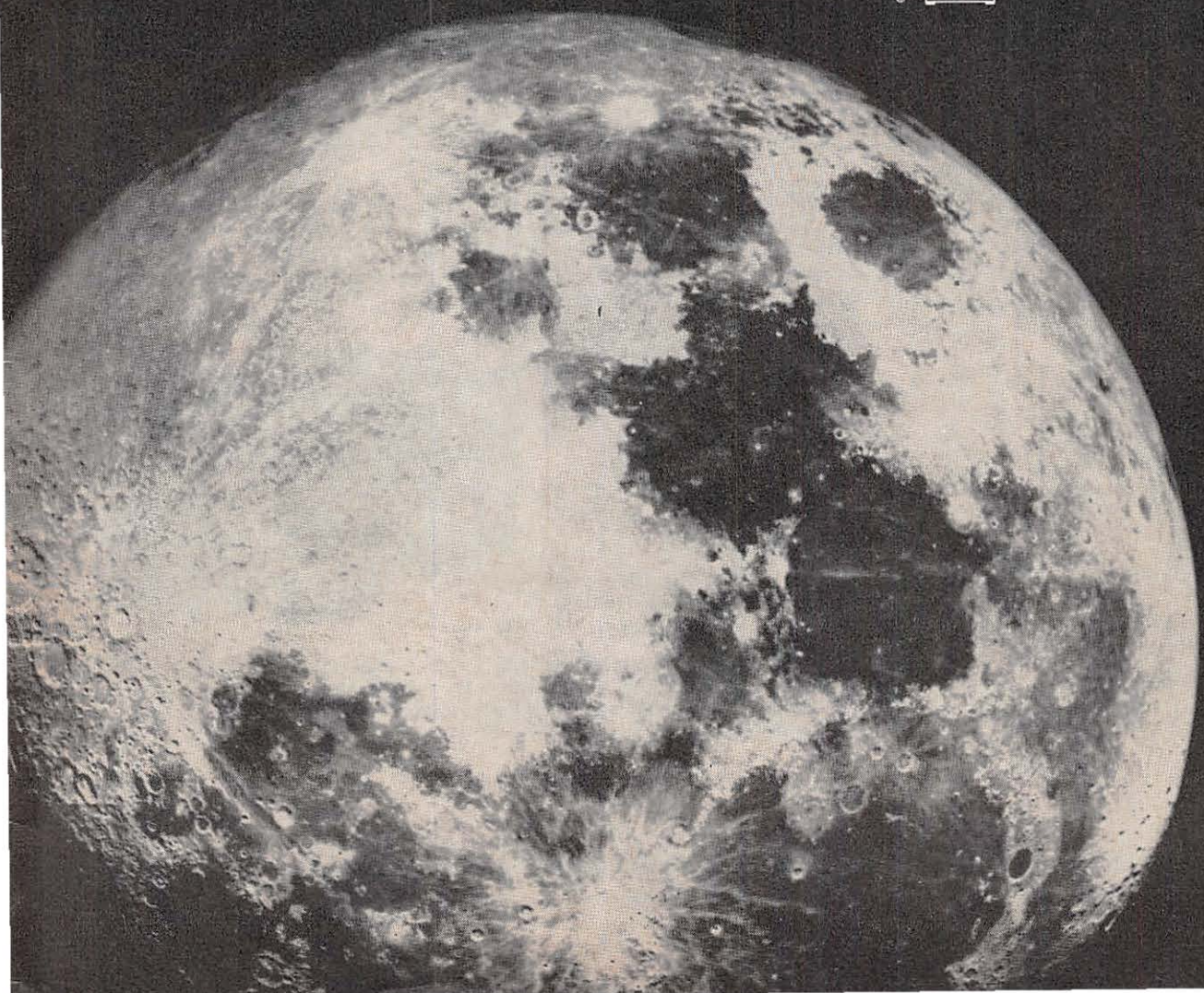

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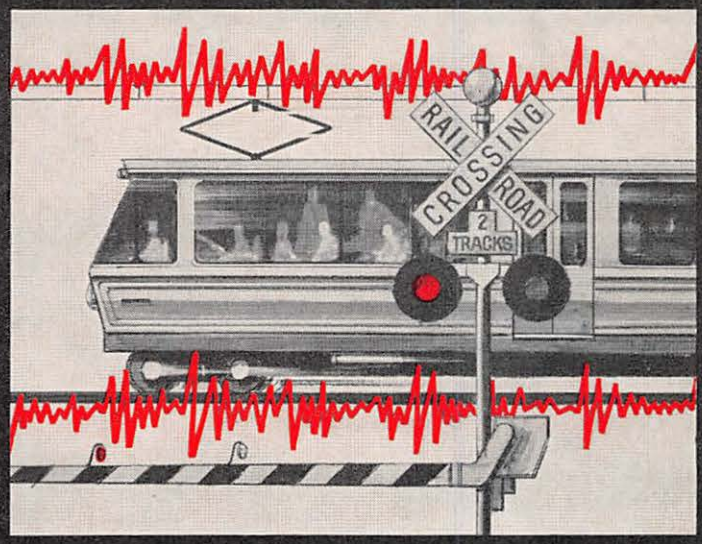

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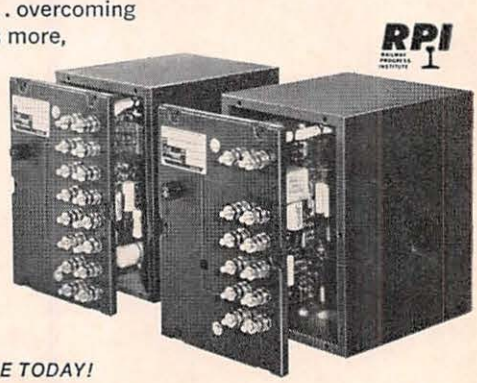

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Editor's Corner

It's later than you think! I'm referring to making your hotel reservations for the annual meeting of the Communication & Signal Section, AAR. This year will have the added attraction of visiting a foreign country, namely our friendly Canadian neighbors to the north. The meeting will be at the Queen Elizabeth hotel in Montreal, Quebec, September 16-18.

In addition to providing the opportunity to renew acquaintances, the C&S annual meeting affords signal and communications officers the chance to get away from home road problems. Exhibits of the Railway Signal & Communications Suppliers Association will feature the latest developments in equipment and systems.

One of the biggest advantages of the annual meeting is the opportunity for S&C men to swap experiences, problems and solutions. It's educational as well as interesting, and certainly a fine opportunity for the younger members of the S&C profession to "learn" informally. The talent, experience and knowledge of the railway men and manufacturers' representatives attending the annual meeting makes it a veritable gold mine of information for all.

The C&S Section annual meeting is a once-a-year golden opportunity to be fully informed about the latest developments in signaling and communications equipment and systems.

One thing is sure, there are many challenges now and in the near future for signal and communications men—communications to meet the information explosion, highway grade crossing safety, improved classification yard controls to increase terminal efficiency, automated transit controls, automatic car identification, TRAIN, electrification and high voltage DC power transmission, to name a few.

Microwave performance standards and hotbox detector operation and maintenance are scheduled for discussion. With at least 10 years of operational experience with each of these two electronic systems, much meaningful dialogue and information exchange should accrue to those attending this year's annual meeting.

Also, the C&S annual meeting provides the one location and opportunity where much knowledge can be gained in a relatively short time (2½ days). Superintendents, engineers, designers and their assistants in signaling and communications can "recharge their batteries of knowledge."

So heed the call—come one, come all to Montreal!

Bob McKnight

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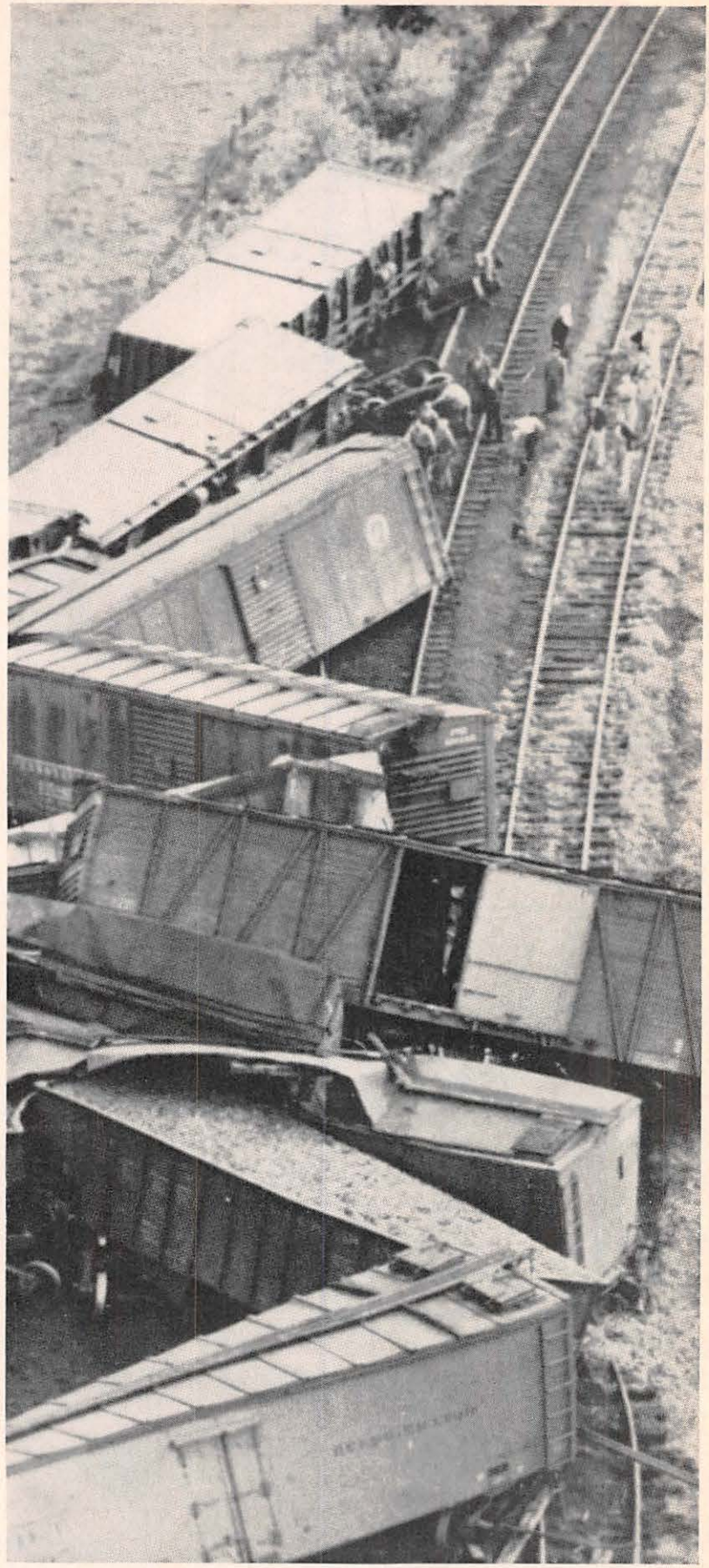

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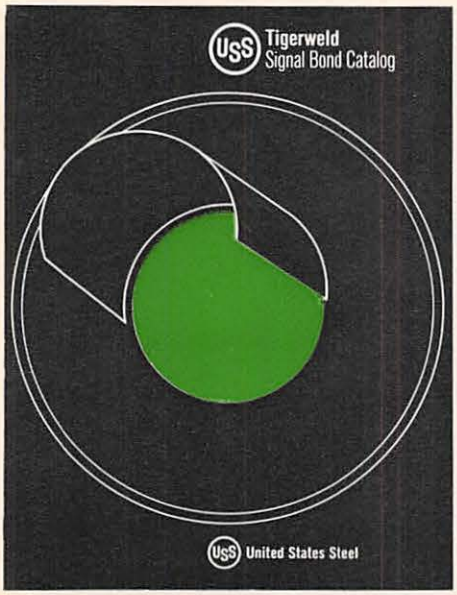

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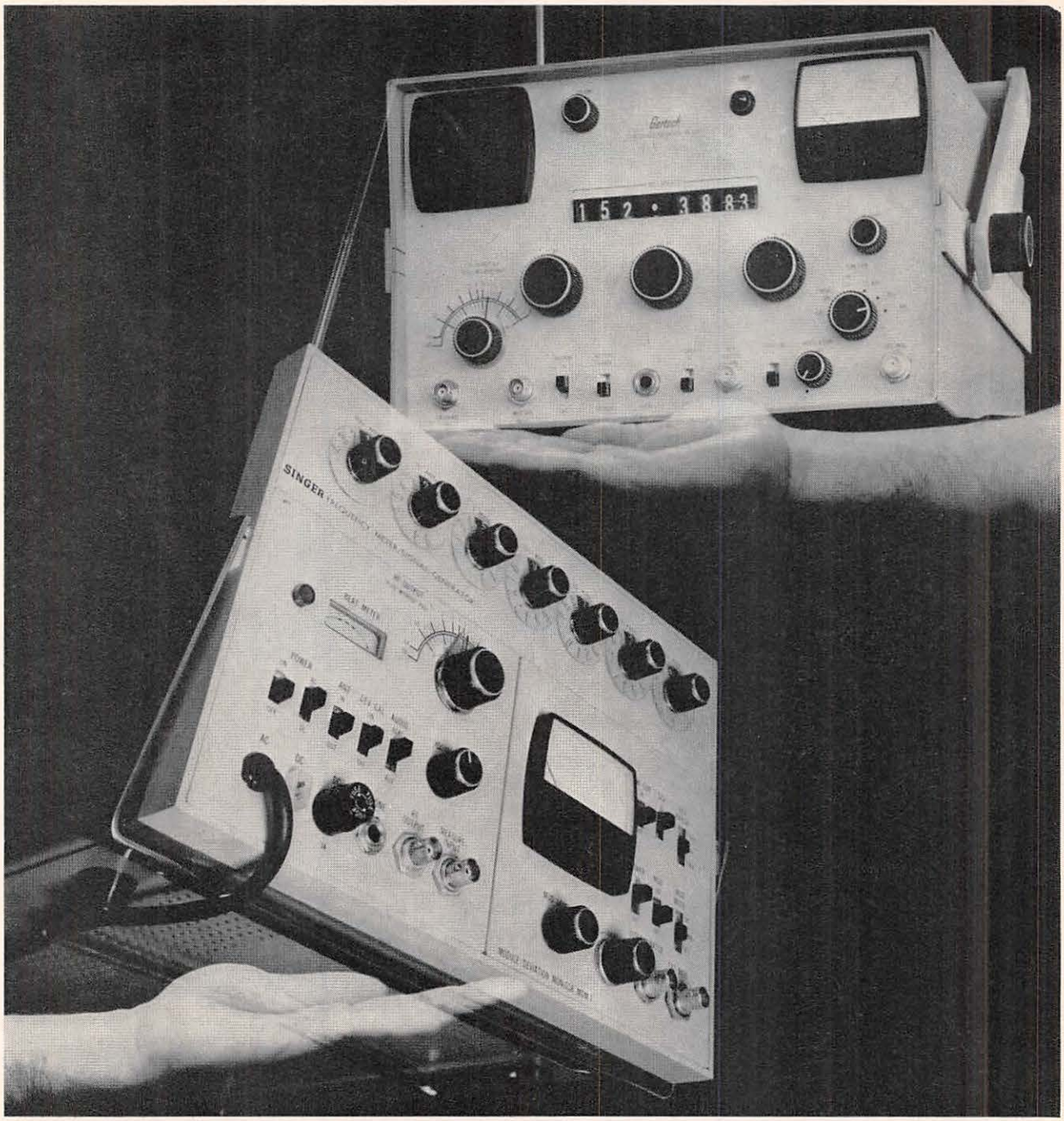

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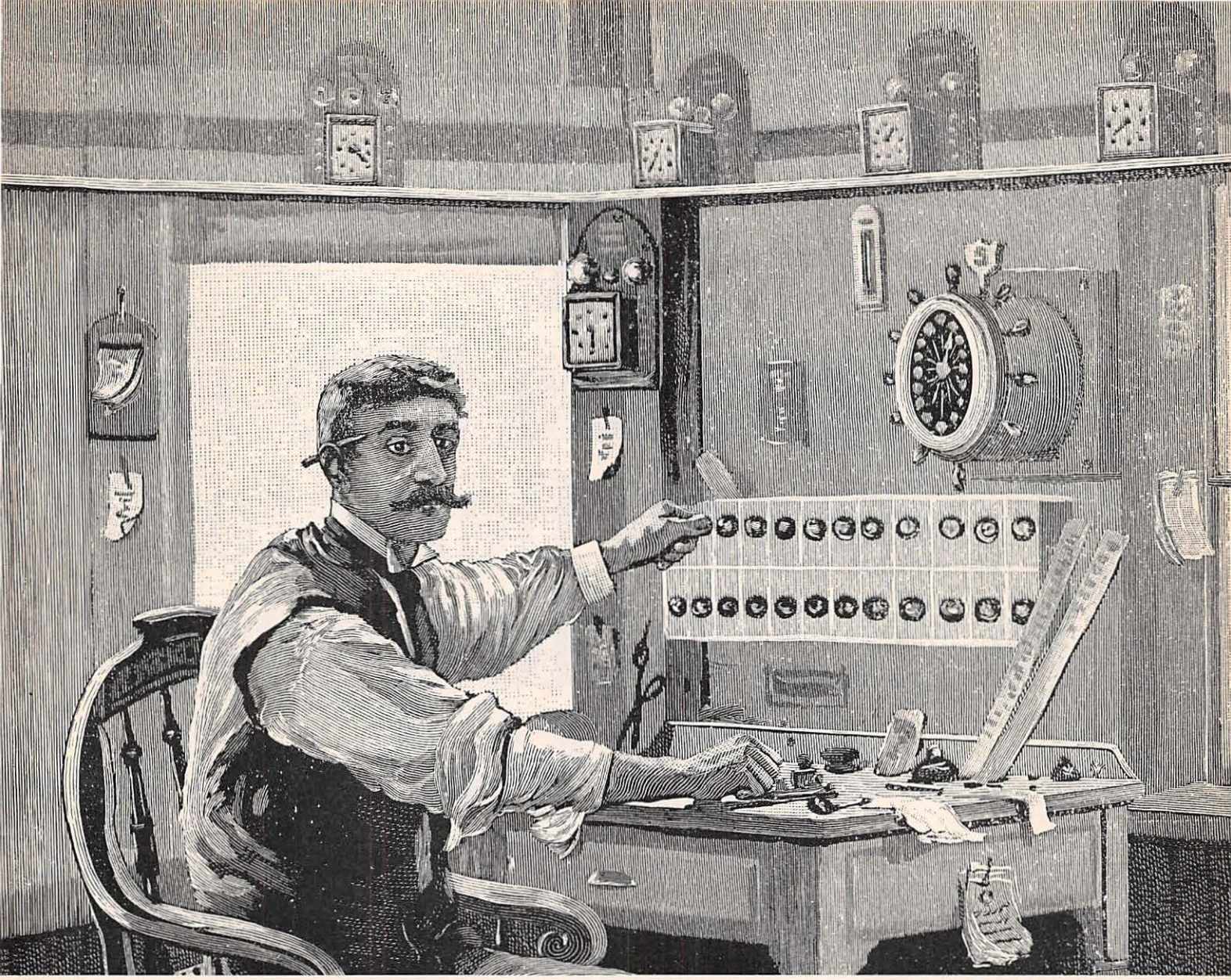

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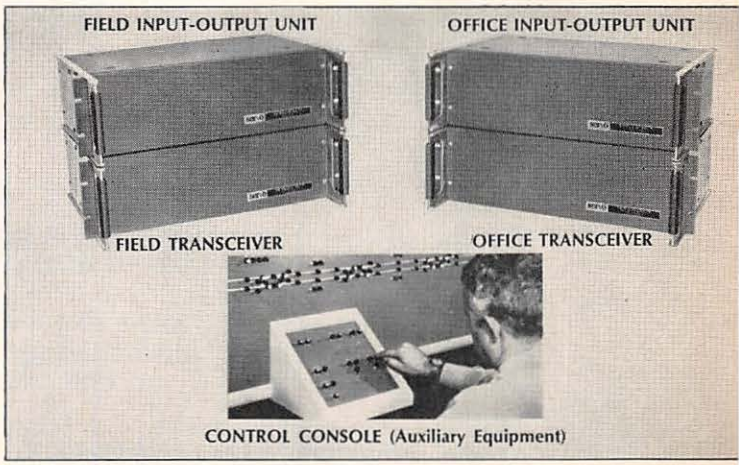

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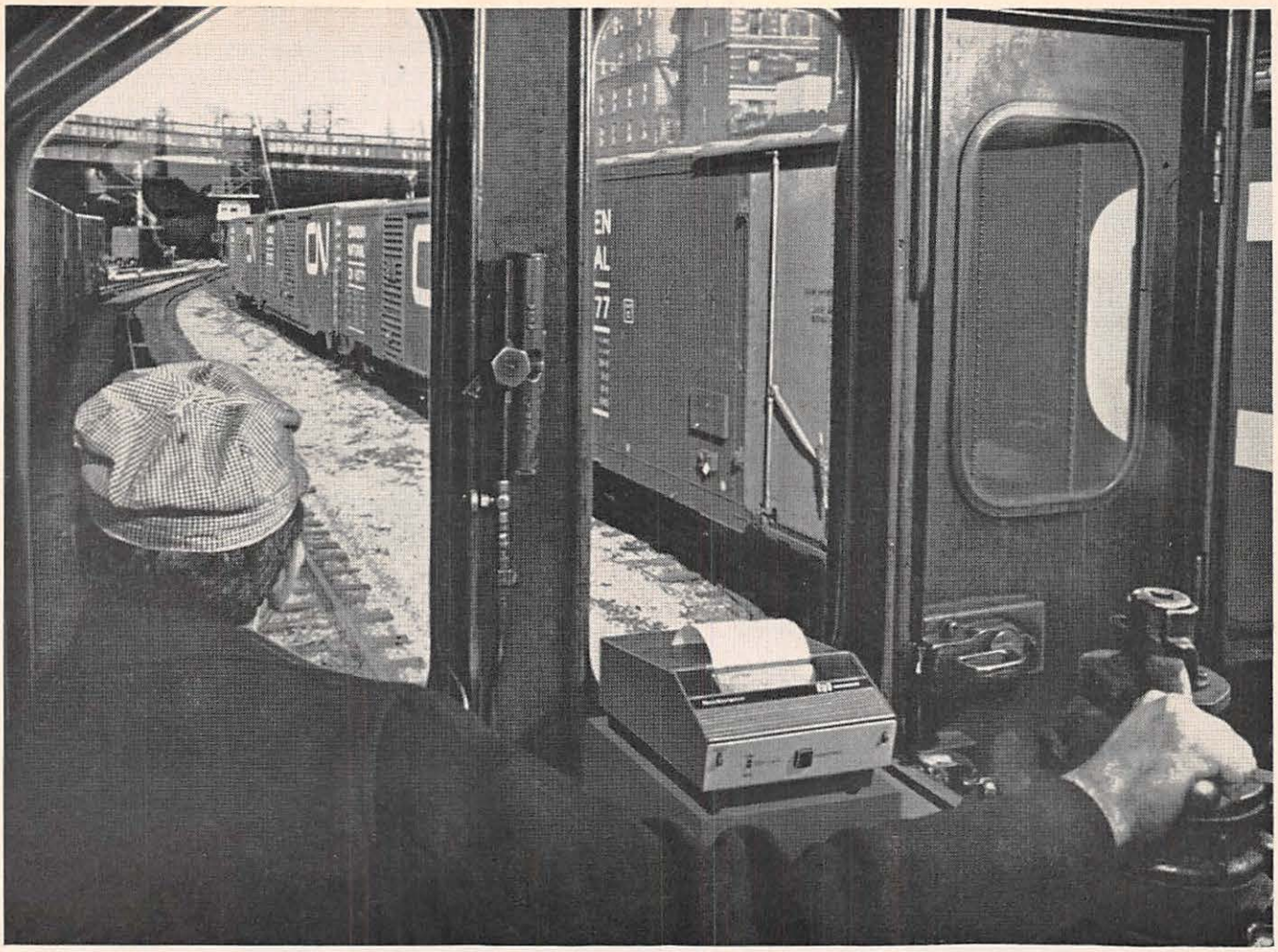

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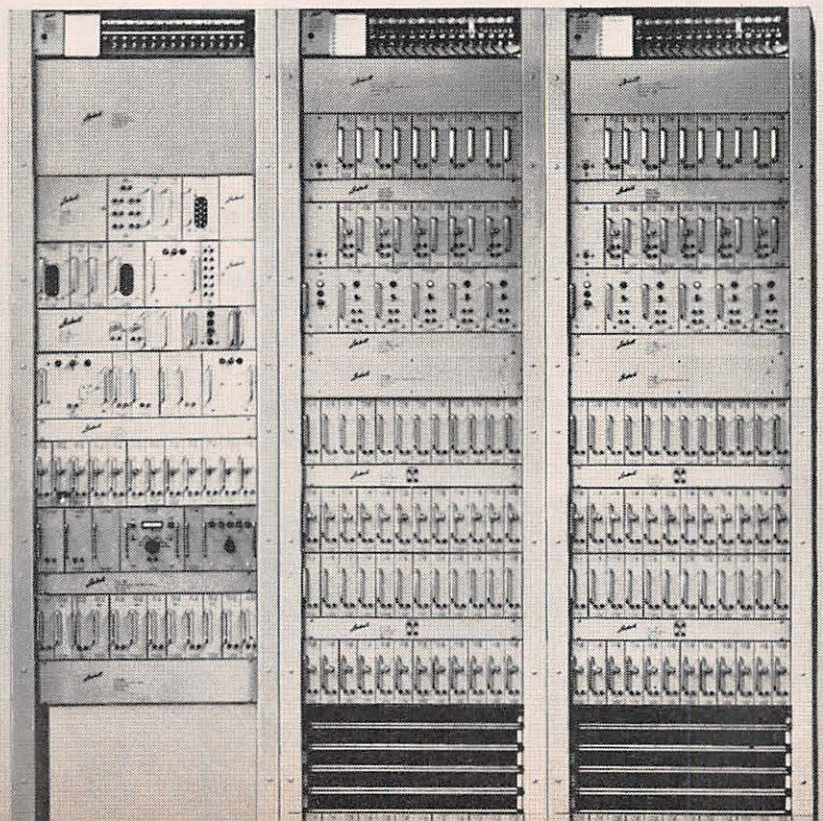


Railway
Signaling &
Communications

Wayside controls are different

By Paul T. Ryan
MERR Project Engineer
Transit Systems Department
General Electric Co.

The Muskingum Electric's wayside control system has several departures from tradition. Vital control functions are handled by industrial type relays. Traffic control is by microwave. Train detection uses limit switches and relay check-in check-out registers. In the loading and unloading areas communication to trains is continuous, using inductively coupled carrier current while on the main line the system uses API (approach position indicator) inert coils to supply intermittent communication.

The industrial type relays used are a rugged, hermetically sealed, telephone type relay. These General Electric relays were originally designed for military applications and have been extensively used in steel mill and numerical machine tool control. Each relay has four sets of dependent front and back contacts, rated 5 amp, 28 volts DC, 115 volts AC. Operating power is approximately ½ watt.

Figure 1 shows the internal construction of one of these relays. Their life expectancy is over 100 million operations which is many times the number they would see in 50 years of service.

In those circuits where failure to drop out would cause a false proceed command, a redundant scheme is used. This decreases the probability of a false proceed since now two relays must simultaneously fail to drop out. Failure of either of the two to drop will result in a train stop which would direct maintenance attention to the faulty relay.

The control system is a self sequencing one. Once both trains are in place on the system and the cycle is started, each event follows as a result of completion of the prior event. Cycle time depends chiefly on main line running time.

Editor's Note: This is the second article in a 4-part series about the control and automation system installed on the Muskingum Electric Railroad. The first article was published in the July 1969 issue of RS&C, pages 22-23, 26.

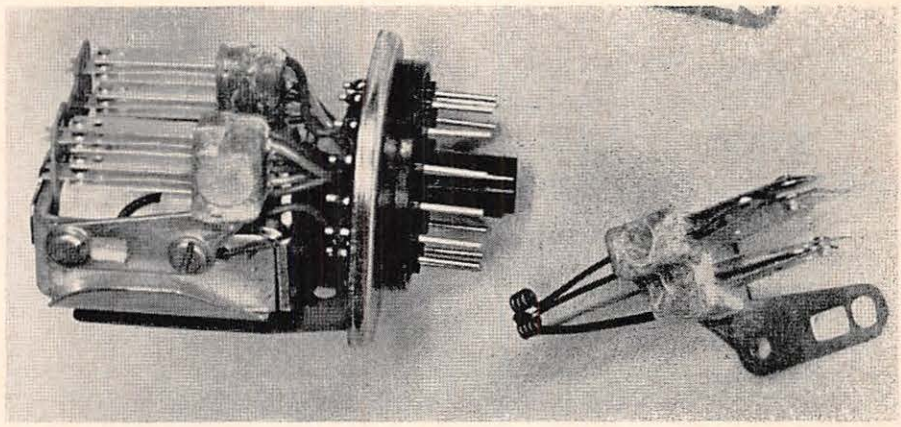


Figure 1—Internal construction of industrial-type relays.

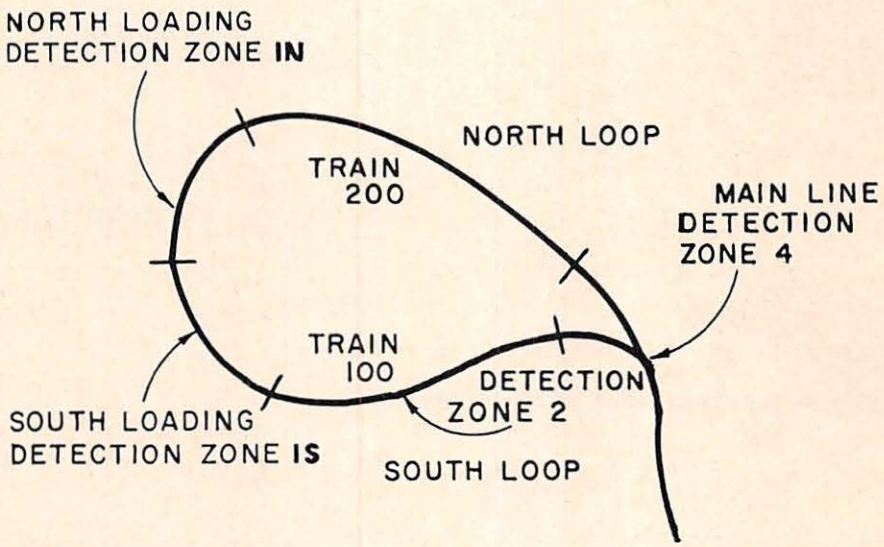


Figure 2—North end of railroad where empty trains are loaded with coal.

Loaded train 200 leaves the north loop over switch normal, after train 100 arrives at the south loop (Figure 2). Train 100 will move into the tipple, load, reverse, accelerate, and stop to check brakes. When the brake check is completed, a route request for switch reverse will be registered. Train 100 then moves out to the park zone and waits.

Meanwhile, train 200 arrives at the south end of the railroad unloads, reverses, and returns. Round trip time is 65 minutes; loading takes 45 minutes, so after a wait of 20 minutes, train 200 returns to the north loop. When it has cleared the switch, the switch moves reverse for train 100 which then departs.

Choice of a check-in check-out system for train detection was based on several factors:

(1) There will be a maximum of two trains on the system only one of which is on the main line.

(2) An economical system was required for this industrial application.

(3) Maintenance personnel are not trained signalmen.

(4) The railroad intends periodic in-

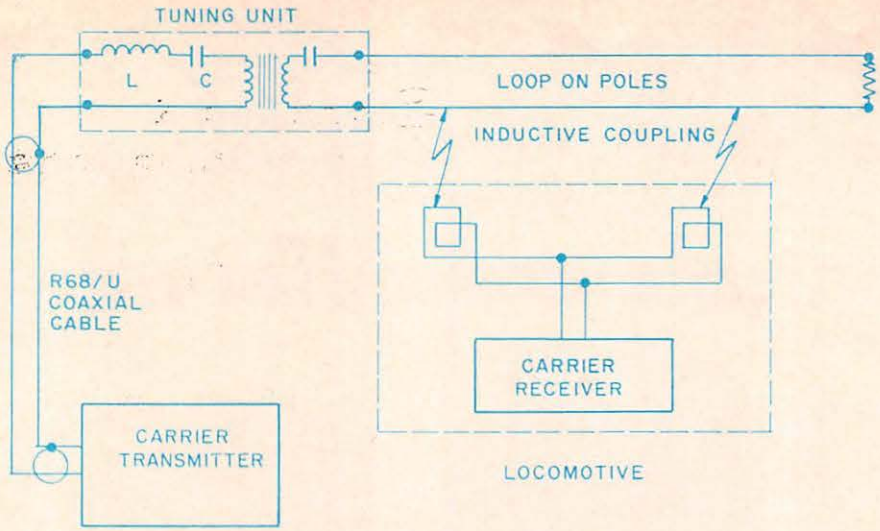


Figure 3—Schematic of a continuous communication zone.

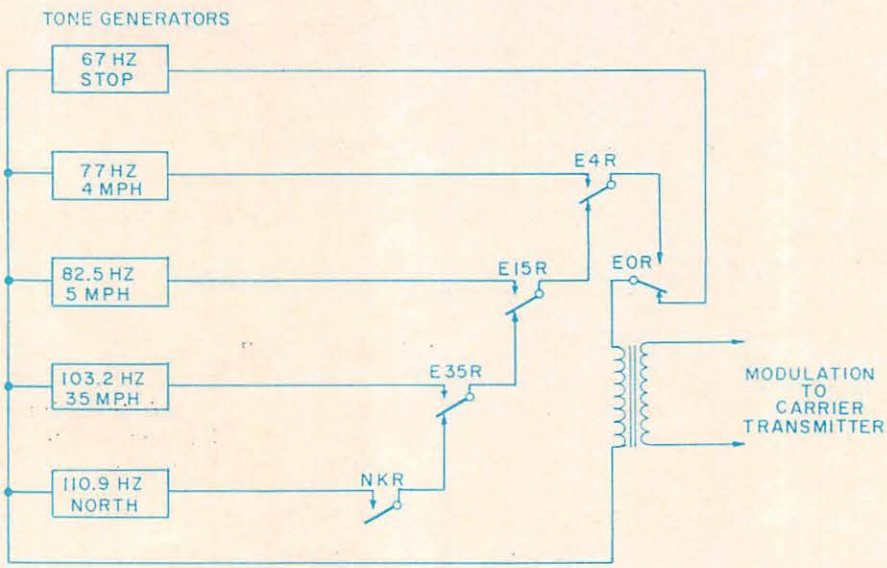


Figure 4—Tone modulation priority ladder circuits.

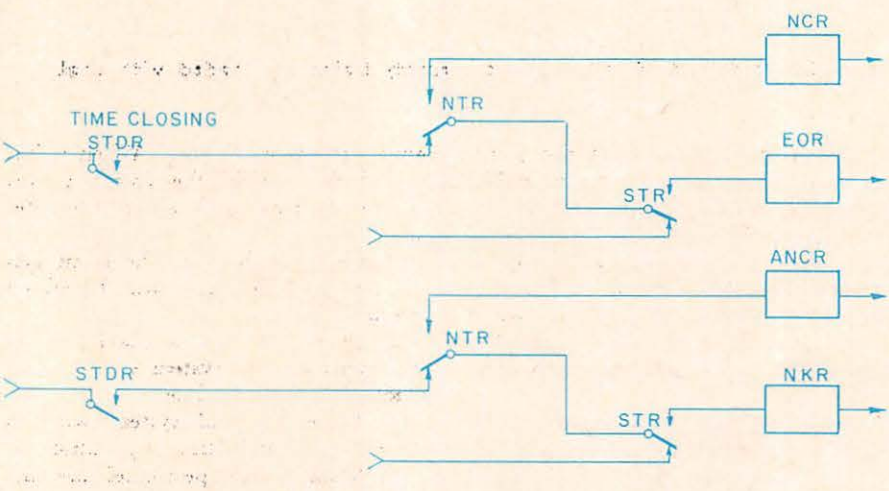


Figure 5—South end command relay control circuits.

spection for rail flaws, to protect against broken rail.

(5) A track circuit system would add additional development work due to the 25 KV, 60 Hz supply system.

The tipple operator has a number of override controls on the system when it is in automatic mode.

(1) Catenary trip—opens 25 KV circuit breaker and causes both trains to stop.

(2) Catenary reset—will close 25 KV circuit breaker unless it was tripped by a fault. Locomotives will not restart, however, since pantographs retract after three seconds with no voltage and must be raised by a control switch in the cab.

(3) System stop—causes all continuous zones at both ends of the system to send stop command.

(4) Stop—will stop trains in continuous zones at north (loading) end.

(5) Hold—three controls are provided, which can hold the train in either park zone or under the tipple when loading is completed.

In the manual mode, all continuous zones are at stop and the trains must be operated by drivers. The tipple operator can operate the loop entrance switch remotely, after the expiration of a time locking period.

The detection system will continue to track trains when wayside control is in manual. However, isolated cuts of cars and the radio controlled diesel-electric switch engine are not detected and must be accounted for before automatic operation is resumed.

The 200 KHz carrier signal for each zone is supplied to the inductive loop from a pole mounted tuning box. Each tuning unit in turn is directly connected to its centrally located transmitter by buried coaxial cable. Figure 3 is a schematic of this communication link.

Speed command tones are keyed into each zone transmitter over a priority ladder as shown in Figure 4 for a typical zone. For each command to be sent, all lower speed relays must be dropped out and the remove zero command relay EOR picked up. Here there is also a self checking feature. If any speed relay sticks, NKR will not cause the train to reverse and go north. Cycling of EOR is checked elsewhere.

Figure 5 shows the control for reversing a train and allowing the system to proceed. In this case the train arrives at the south end of the system and transmits the position of its reverser—southbound (forward). This picks up relay STR. After a time delay to allow the train to come to rest, STDR contacts close, EOR and NKR are picked up over NTR down, and north command is transmitted to the train. As soon as the train transmits northbound

(reverse) position of its reverser, STR drops, NTR picks up and NCR and ANCR are picked up to start the northbound sequence.

Train detection is performed by a secure system of limit switches and relay counting logic. Figure 6 shows a limit switch and magnet supported by a bracket from the ties and two ½" x 18" steel vanes mounted on the locomotive truck. The limit switch reed element is held closed by its magnet until flux is interrupted by the vane on the locomotive.

Each zone boundary is marked by two limit switches, spaced 9 ft apart to correspond to the spacing of vanes on the No. 1 truck, left side, of each electric locomotive.

Detection for the north loop parking zone is shown schematically in Figure 7. The limit switches are designated 9A, 9B, 11A, 11B. Each limit switch operates a relay—9AR is shown. The relays are connected into four networks, 9 north, 9 south, 11 north, 11 south, corresponding to the entrance or exit at the 9 (west) or 11 (east) end of the zone.

Network 11S is shown. When the locomotive moves through the limit switch pair, the sequence 11A, 11A and B, 11B results in relays 11SFR and 11SGR sticking up.

Moving through the limit switches backward will drop out 11SFR and 11SGR but will leave 11SCR picked up. To drop it, and as a precaution against a stuck relay, energy to the network is broken by limit switches 7A and B at the western end of the next zone.

Replacing the conventional track relay is a pair of presence relays 3PR, 3APR. These will be held up by 11SFR and 11SGR if train exited southbound to the mainline or by 9NFR and 9NGR if train exited northbound to the loading zone.

Train direction register circuits are shown in Figure 8.

Train direction is registered for 3 segments of the railroad—south loop, north loop, and main line. Each direction is registered by a pair of stick relays, 2SDR, 2NDR; 3SDR, 3NDR, 4SDR, 4NDR respectively.

Since one receiver is used at the north end to check direction of both trains, choice of which loop (north or south) requires the south direction is made based on the combination of train presence on one half and absence in the other.

For example, in the south half of the loop, south direction is registered by receipt of south direction confirmation (SCR, ASCR up) with north loop clear (1NPR up) and south loop occupied (1SPR down). After the other train has

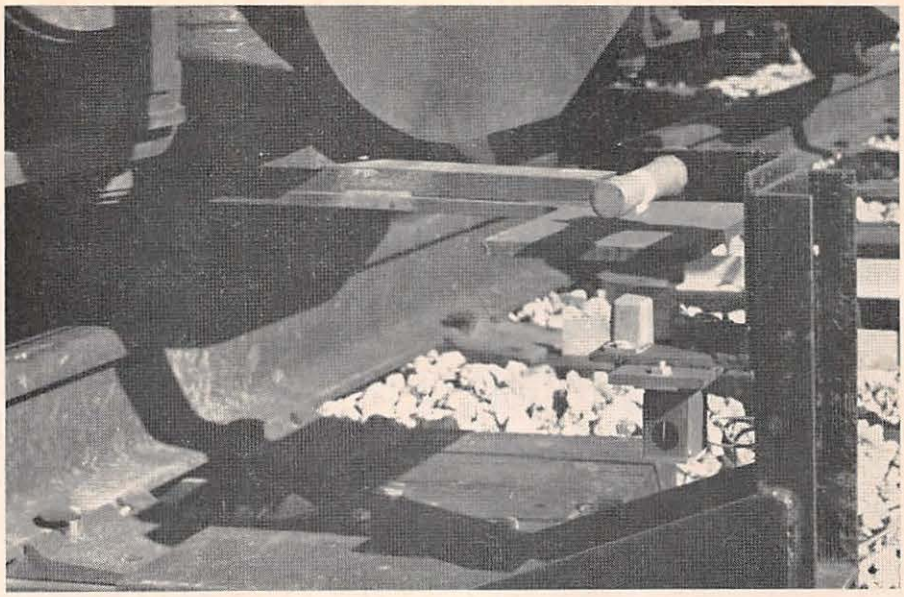


Figure 6—Locomotive-carried vane and limit switch.

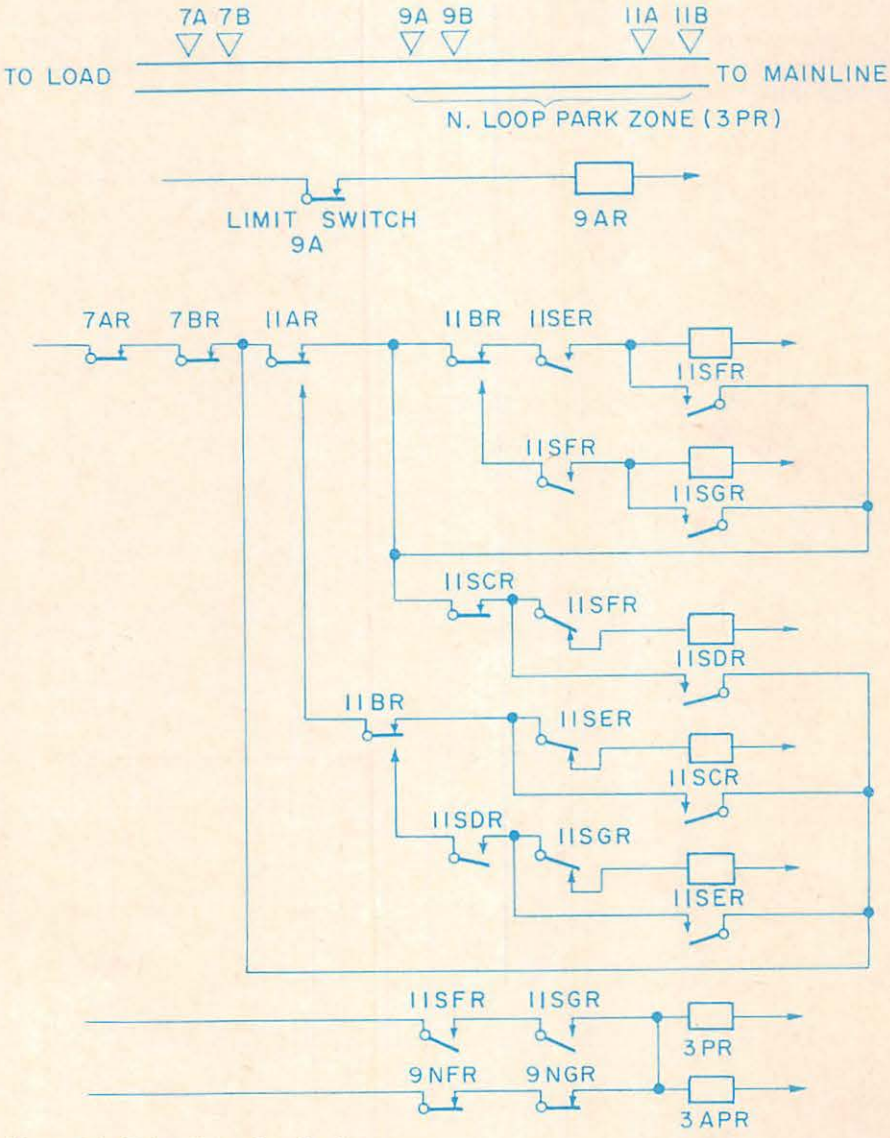


Figure 7—Detection circuit plans.

returned to the north loop, the switch throws and south direction for the main line is registered from the south direction in the south half of the loop over front contacts of switch reverse correspondence relay (RWC).

When the train reaches the south terminal and reverses, this fact is sent over the microwave channel to the north end which picks up relay NFR to change direction over the route, i.e., main line and north half of loop.

The direction and train detection stick relays are protected from dropping due to power outage by a nickel-cadmium battery with capacity for 15 minutes. In the event control power (115 volts 60 Hz) is lost while the 25 KV to the electric locomotive is not, trains in continuous zones will stop due to failure of carrier transmission. A train on the main line intermittent zone would continue to the end of the intermittent zone and then stop.

Figure 9 shows circuitry for control of tone keying relays for the north end of the main line continuous zone, including the two routes over the switch. NGR, RGR, NAGR and RAGR are relays which check switch correspondence (normal and reverse) and dispatch permitted southbound.

5SDR, 4NDR are direction relays for main line and 2PR, 3PR are presence relays for south and north parking zones in the loop.

15MR is a stick relay which can be picked up by the approaching northbound train through a limit switch to expedite movement over the switch at the loop entrance. This pick up is prevented if it is desired to hold the empty inbound train in the parking area.

Audio frequency tones transmitted over a single two-direction microwave channel will close the loop for cycle checking between the north and south end continuous zone control systems, and provide a number of auxiliary functions.

Functions from north to south are:

(1) Dispatch permitted northbound. This checks that route is locked for return and continuous zone is at stop or 4 mph, not higher.

(2) Don't stop (removal causes stop at south end).

(3) Hold train at south end.

Functions from south to north are:

(1) Dispatch permitted southbound —this checks that south end continuous zone is stop or 4 mph, not higher, and south end direction is not "north".

(2) Train arrived.

(3) Train reversed.

(4) Continuous zone is set to stop.

(5) Channel intact.

Loss of communication in either direction will cause all continuous zones to transmit stop.

An interesting application of modern electronic instrumentation was used to lay out the 12-mile intermittent zone into 15 equal increments for placement of the API units.

One of the electric locomotives was equipped with a pulse counter connected to the same tachometer used for distance measuring in the intermittent control mode. A run southbound was made, counting 121,065 pulses between ends of the continuous zones. On the return trip a paint mark was sprayed on the rail every 8071 counts. This "survey" closed within 20 feet, and allowed two men to complete the layout in about three hours.

Speed is held to 25 mph for loaded trains down a 2% grade to stay within the rating of the locomotive dynamic brakes. Train performance computer programs which give speed-time-distance information were used to locate the 25 mph speed limit API units and the boundaries for the continuous communication zones.

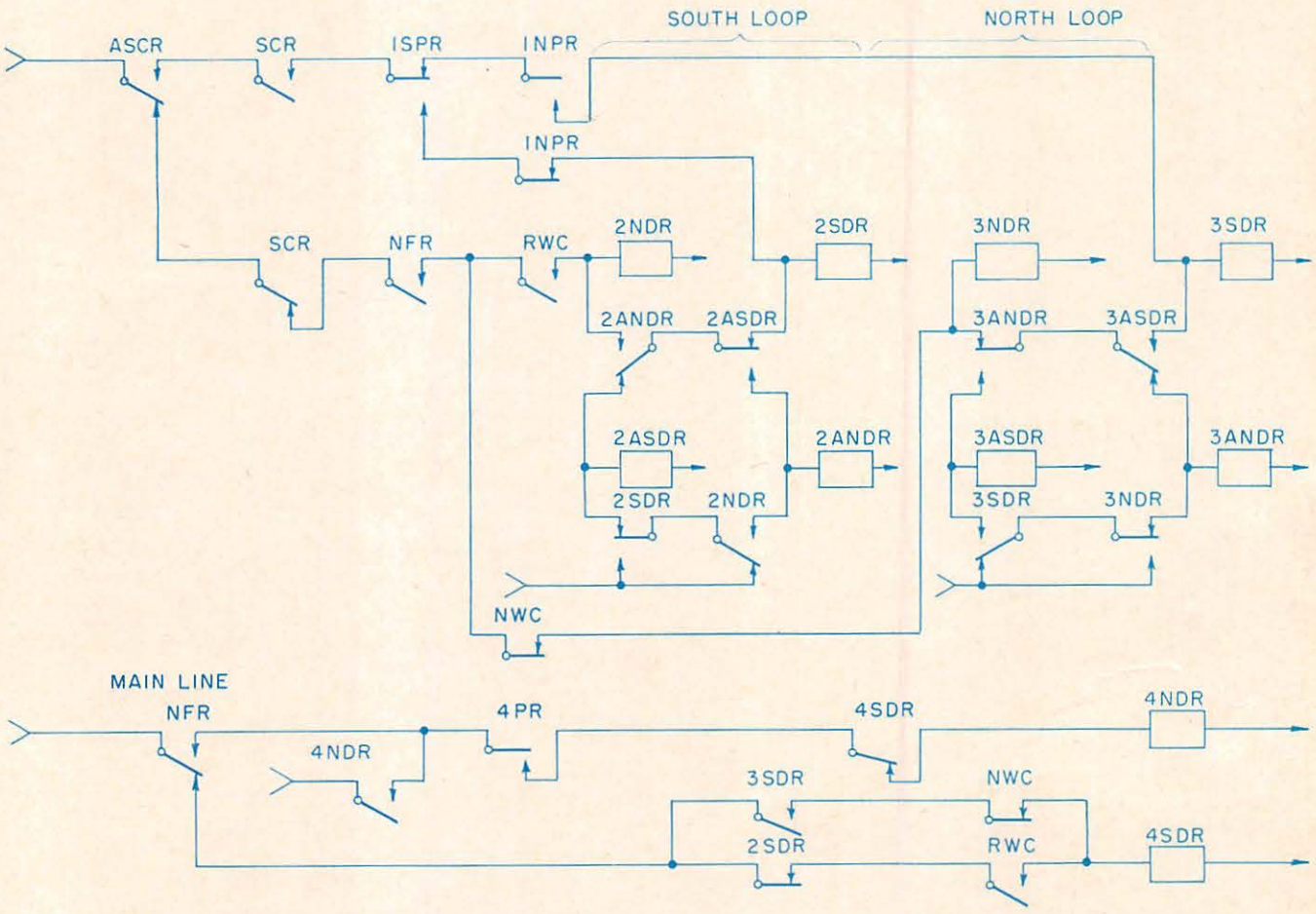


Figure 8—Plans of train direction register circuits.

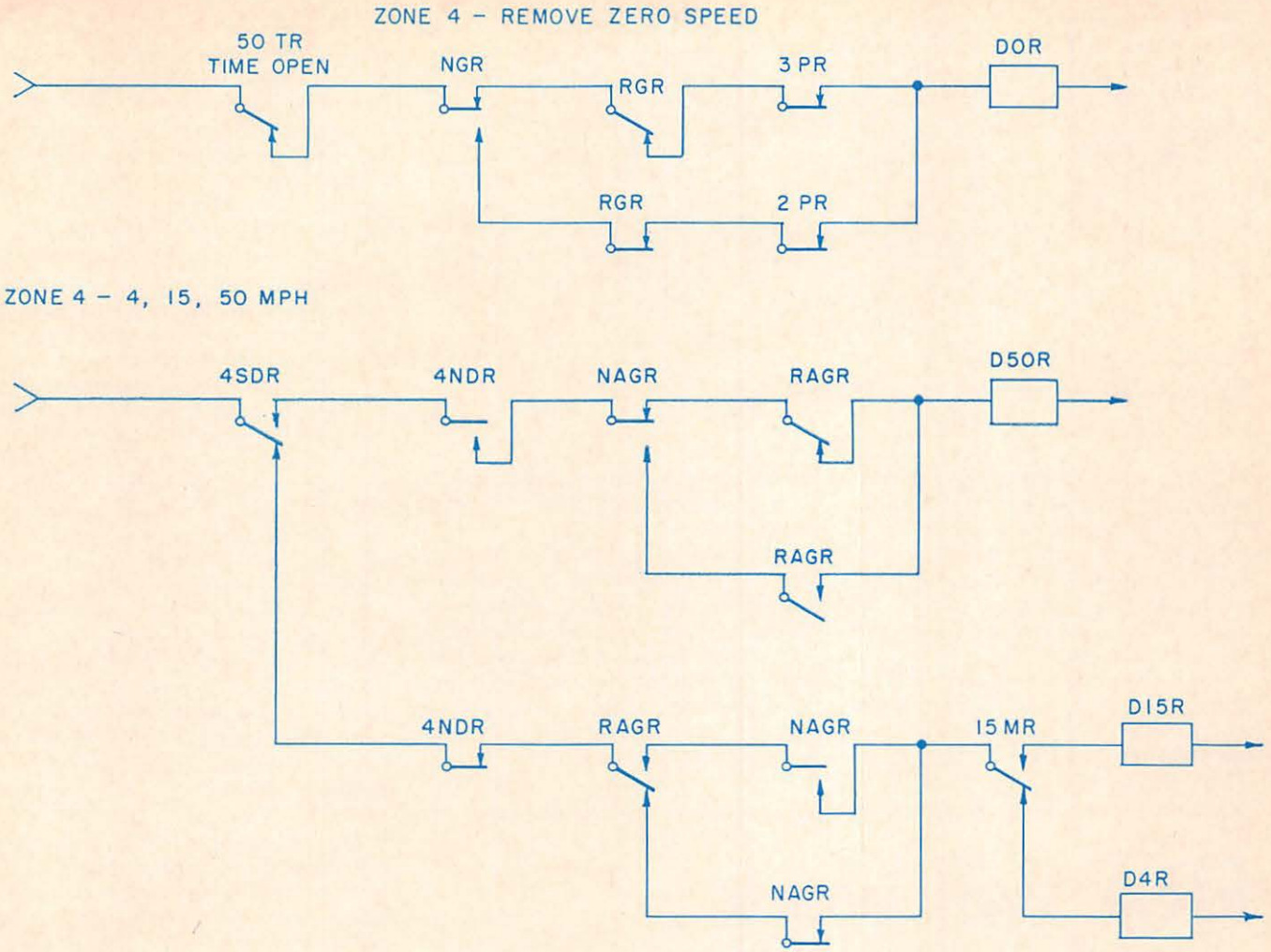


Figure 9—Circuit plans for speed control for mainline, north end.

The cars are automatically loaded with coal from a surge hopper located over the track. When a train is detected in-bound on either half of the loop, the telescoping coal chute extension is lowered against stops to the correct height for the top of the car load.

As each car enters the tipple, a vane on the right side leading end truck actuates a limit switch. this switch operates solenoid valves to control the air cylinders which open the coal gates. The gates remain open until the vane on the left side trailing truck operates a limit switch to close them. Figure 10 shows the vane welded to the top center of the contact rail.

Gate opening and closing limit switches are selected by contacts in train presence and direction circuits. When the entire train is loaded, it stops and reverses. Receipt of the south-bound message from the locomotive deactivates the coal gate control and raises the chute extension clear of the coal.

Manual override is provided for the gate control to allow the tipple operator to skip a car if required.

Automatic unloading takes place at

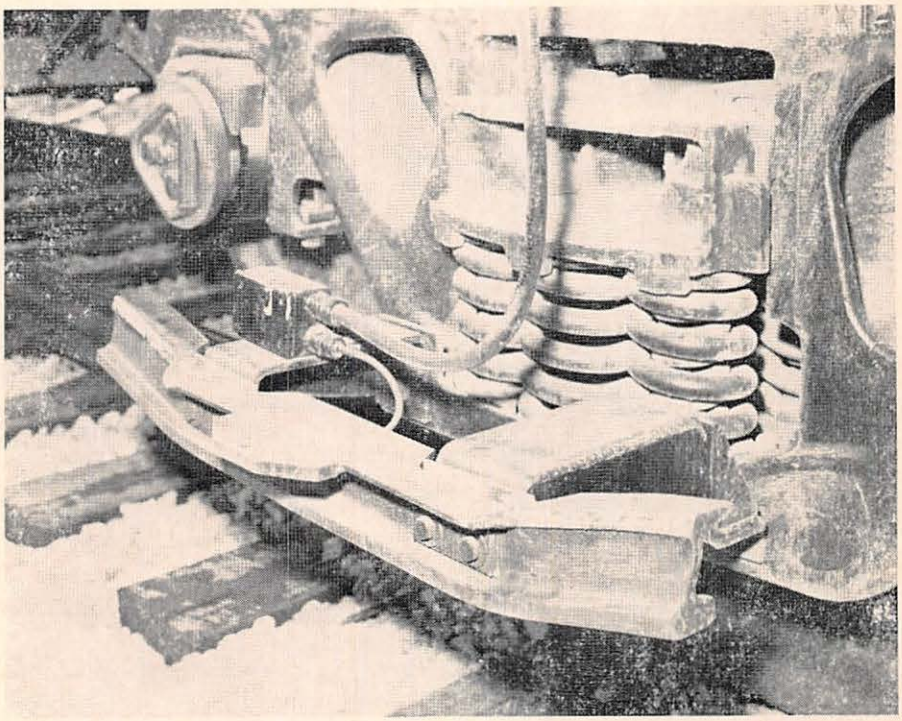


Figure 10—Hopper car contact rail has vane welded atop it at center.

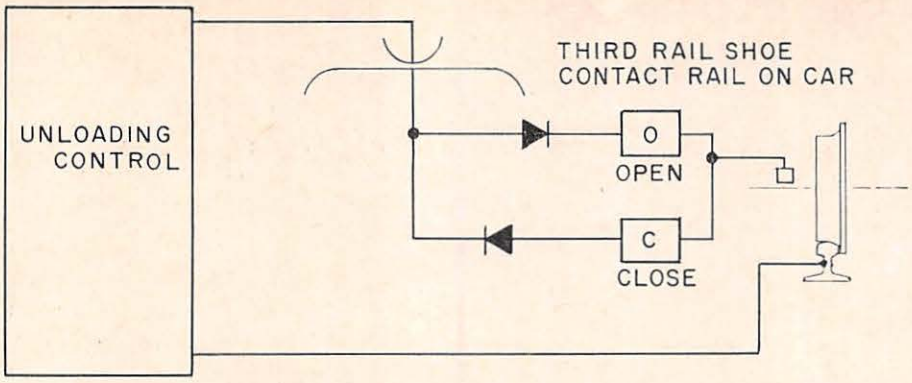


Figure 11—Hopper car door solenoid valve circuit.

the south end. Air pressure to operate car doors is stored on each car, supplied by a second air line, separate from the brake line. A two-coil two-position solenoid valve controls the air to the operating cylinder. Figure 10 shows the contact rails located at right front and left rear of the car.

Figure 11 shows the electrical circuit for the car door valve. The shoe is energized positive when the train enters the detection zone, polarity is reversed when the train reverses, and the shoe is de-energized when the train leaves the zone.

A second shoe, north of the one shown is energized for alternate cars through a relay counting scheme controlled by a vane actuated limit switch.

This system, in successful operation since early spring, has service proven the application of this new approach to automatic train control on a fully automated rail haulage system.

FRA will work with railroads

By Mac E. Rogers Director
Bureau of Railroad Safety
Federal Railroad Administration
Department of Transportation

We would like to work toward something of a more permanent solution in our approach to rail safety problems as we see them today. I'd like to take a few moments here to outline or briefly discuss how we are moving in this area by speaking of the appointment of a special task force group, nominated by Secretary of Transportation, John A. Volpe. The group chaired by Federal Railroad Administrator, R. N. Whitman, was selected from top level executives from railroads, railway labor organizations, and the national associations of regulatory and utility commissioners as members. Secretary Volpe asked the task force to key in on four major areas. They are: 1) examine the scope and nature of the railroad safety problem; 2) review present federal railroad safety statutes relative to accident causes; 3) identify priorities and joint rail safety programs; and 4) report and recommend appropriate activities and procedures in structuring solutions. The group's first meeting was held in Washington, D.C. on May 1 and it is hoped that within the next 60 days a report will be drafted by the Committee for consideration of the Secretary.

The National Transportation Safety Board is included as a part of the Department of Transportation and concerns itself with improving safety of all modes of transportation. It operates within the Department but functions independently of the Secretary, reporting directly to Congress and it has been described by some writers as the "Supreme Court of Safety".

Under our present method of organization the Bureau of Railroad Safety will consist of a Director's office and four major divisions. The Engineering and Accident Analysis, the Safety Programs, the Field Operations and Administrative Services Divisions. The field operation will continue under our present system, consisting of 7 regions. The Safety Programs Division will administer and enforce regulations relative to the Signal Inspection Act, the Safety Appliance Act, Hours of Service Act, Accident Reports Act, Medals of Honor Act, Power Brake Law, and rail transportation of hazardous materials; analyze and evaluate field reports, recommend field program guidelines and procedures and conduct a continuing internal, technical training program.

We plan to look to our Engineering Accident Analysis Division to provide leadership, investigation of major accidents, including the causal analysis of rail accidents, to provide engineering expertise to other elements of our Bureau and to coordinate the technical aspects of our operation. This Division will initiate rules and standards revisions; maintain liaison with carriers, research organizations and equipment manufacturers, and investigate safety devices. We recently brought on board to head this Division, Robert H. Wright, former Manager of the Penn Central Research Laboratory in Cleveland, Ohio.

We are convinced that even as we call upon the railroad industry to improve its safety performance, we ourselves must be doing everything we can to improve our performance in this common area of concern. At the same time we plan to provide within the framework of our reorganization, an intensive continuing program of training for our field inspection personnel. Just as we see a need for better training of railroad operating and maintenance personnel, we also see a need for better training of our own people. If our plans materialize for our railroad accident investigation school we will no doubt be in contact with your officers to work out a part of the course to include some of the outstanding instructors from your Communication and Signal Section.

Our final 1968 figures are not available, however, a look at the preliminary data indicates a continuing rise in train accidents, and we feel very strongly that the industry, its employees, and governing bodies as the regulatory agents must come to grips with the problem of safety.

A problem of serious proportion that has developed or at least has forcibly come to our attention during the past few months has been the number of train accidents involving tank cars containing propane gas.

When we are talking about the inherent hazards of nitrogen tetroxide, liquid hydrogen, clorine, phosgene, nerve gas, or other potential disaster

Editor's Note: Abstract of a talk presented to Eastern Sectional Meeting, Communication and Signal Section, AAR, May 14, 1969 at Arlington, Va.

agents, the need for a new look in the transport of these products is apparent. As an illustration, one tank car loaded with nitrogen tetroxide could under the right weather conditions kill 100,000 people if rupture should occur. One tank load of nerve gas or phosgene would create a similar catastrophe. A tank load of hydrogen could wipe out a city block. Unfortunately, no matter how logical the demand is for appropriate action in the area of hazardous materials transportation, it sometimes takes a crisis or a disaster to precipitate full scale action.

We in FRA are aware of the frustrations, inconvenience, loss of business and so forth, that can be suffered by shippers and consignees alike when train accidents of major proportions occur.

Concerned at the yearly rise in train accidents, occuring outside of FRA jurisdiction, influenced the Department of Transportation to ask Congress for broader authority to match that now exercised in air, water and highway safety last year. When introduced, our former Secretary remarked that he did not suggest that the railroad industry was insensitive to its responsibility for the safe operation. However, as with other modes of transportation, costs and competitive pressures can frequently work at cross purposes to safety and that the cost of greater safety would be borne reluctantly unless it is a burden which falls evenly on every member of the industry. Our proposed Bill was not enacted, (As a matter of information somewhat similar bills have already been introduced in both houses and Senator Hartke's Sub-Committee will start hearings in the Senate on May 20).

You may rest assured that if Congress does see fit to provide us with the authority previously described, we will see that fair regulation and standards are developed, only after careful study by the best of talent we can enlist from management, labor, government and other interested parties.

During the past fiscal year our Signal and Train Control Inspectors inspected 95,272 appliances, of this total 5,436 defects were found. In general, this indicates that your signal people are doing a fair job, however, we would like to see a concerted effort on the part of the carriers to reduce the number of defects. Also, during the same period the carriers reported to us 68 false poceed failures and of this amount a total of 10 were caused by errors in making connections or adjustments.

Year end to June 30, 1967, there were 33,262 false restrictive failures reported. Year end to June 30, 1968 there were 37,248 false restrictive failures reported, or an increase of 3,986 failures, which no doubt resulted from improper maintenance.

Here are some additional problem areas.

(1) We are currently making an in-depth study of the impact of radio on safe train operations. We are aware that radio has its place in the expediting of train movements and can be of tremendous value if properly used. However, problems are being encountered and the purpose of this study is to determine solutions in this problem area. In the near future, some of our people will no doubt be calling on some of you for help in resolving this matter.

(2) Another concern of ours is the safe operation of motive power, remotely controlled by radio. We have set up a committee, including railroad people, manufacturer representatives, and other interested parties to survey this problem.

(3) In reviewing carriers operating rules it is noted that each carrier has a set of signal aspects and rules of their own. We believe consideration should be given to the standardization of such aspects and rules so that signaling systems will be uniform throughout the country. Another matter of concern is the spacing of signals for braking distance. Again, from the applications reviewed it is noted that few carriers have the same braking distances. Carriers should get together and we believe it would be beneficial if they could establish standard distances for braking.

(4) Our records of efficiency tests conducted by carriers indicate that several were questionable as to whether or not the proper braking distance was provided.

(5) We are working with the AAR and the manufacturers in trying to determine the adverse affects, if any, high voltage direct current transmission lines now under construction will have on our present and future signaling systems.

(6) An additional area of mutual concern is the improvement of grade crossing safety which has been given a high priority by the Department of Transportation through its 11 point action program. A part of this program deals with the development test of the protection devices possible, that is other than over or under-passes.

Here are a couple of matters in which we hope that an improvement can be made in our own operation.

(1) The number of applications filed with the Bureau requesting modification of signal systems continue to mount, and, at times, causes a serious delay in the processing of the request. At the present time consideration is being given to revision of the ICC Secretary's Notice of March 15, 1954, covering instructions for filing applications for the discontinuance or modification of signaling and train control systems. This proposed revision is expected to expedite the processing of such applications by this Bureau.

(2) In the near future we will make a determined effort to change certain sections of Ex Parte 171, Rules, Standards, and Instructions, covering signaling and train control systems. With the new electronic equipment being applied to signal systems, it becomes necessary to incorporate certain specifications covering the equipment into our present rules.

We do want to again make it crystal clear that if any of you have problems in the area of signals and communication my office is always open and I would be most happy to see you.

Should consider standardization of signal aspects and rules.

We will make a determined effort to change certain sections of Ex Parte 171 of the RS&I.

How to select VHF radio towers

By Grady Rooker
Assistant Sales Manager
Rohn Manufacturing Co.

Your radio and transmitting equipment is only as effective as your radiating antenna and support tower. You more than likely have given considerable time and thought in the selection of your base station equipment. An equal amount of time and thought should be given to your antenna and support tower. Since this article is primarily centered toward the support structure, let us assume your electronic equipment has been selected and that you are now ready for the selection of your supporting tower. The following items are a few that will need answering before you select your tower.

Type of Tower

Basically, two types of towers can be considered: a self-supporting type or a guyed type.

The self-supporting tower is normally used when it is necessary to eliminate guy wires due to lack of property or being located in a congested area. The real estate required for a self-supporting type tower is small compared to that for a guyed tower. The space required could be as small as 3 ft square for short towers and up to 50 ft or more for tall towers. The self-supporting tower requires a good foundation and, in all cases, must be concrete. The installation of the base should be done with great care and precaution. Base anchor bolts and base foundation should be level in all respects. Your tower manufacturer will provide you with the necessary base foundation details for your particular installation.

The advantages of the self-supporting tower are: less space required for installation, attractive in appearance, and does not normally interfere with the radiation pattern of the antenna. However, these disadvantages should also be noted: the basic tower cost is greater, cost of foundation and erection is greater, and additional future antenna load is not possible unless original tower design provided for this additional load.

The guyed tower is the most widely used type in the two-way communications field. Guyed towers are normally of triangular construction and vary in size depending upon the type of antenna load and the height required. Guy anchors are normally placed 120 degrees apart around the tower base and are located approximately 80% of the height of the tower from the base of the tower itself. This means that a 100 ft tower would have its guy anchor points 80 ft from the base of the tower. This 80% figure can vary to a lesser amount; however, caution should be used. If 80% cannot be attained due to lack of real estate, it might be necessary to increase the number or size of guy wires which would normally be used in the 80% calculated figure. If a shorter radius is required, consult your tower manufacturer.

The following advantages are usually found in guyed towers: less material costs than self-supporting towers, lower erection costs, foundations are normally less, and some antenna load can be added if additional guy wires are installed (here, again, this should be checked with the manufacturer). The

Height Zone (above ground)	Loading Zone A	B	C
Portion of tower 300 feet and under	30	40	50
Portion of tower 301 feet-650 feet	35	48	60
Portion of tower over 650 feet	40	55	70

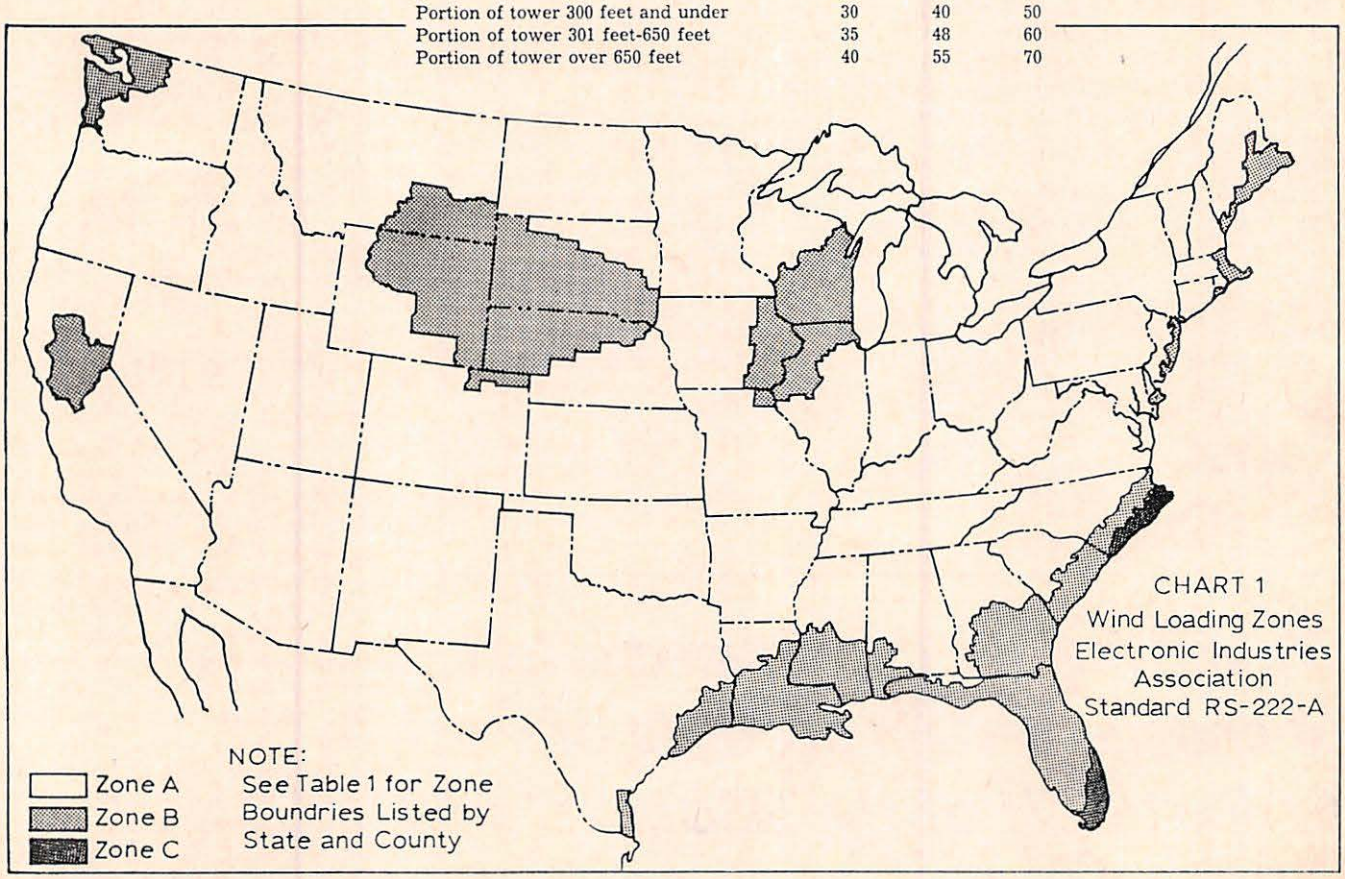


CHART 1
Wind Loading Zones
Electronic Industries Association
Standard RS-222-A

only real, constructive disadvantage in a guyed tower is that more land is required. However, many times the additional cost for the real estate will more than offset the greater initial cost for the self-supporting tower.

Selecting Your Tower

By now you know what type of tower you require. To properly engineer your tower, all reputable tower companies (I qualify "reputable" as being tower manufacturers who employ full time engineering departments with licensed, engineers) would require the following information: (a) Type of tower—guyed or self-supporting; (b) Height; (c) Tower placement—ground or roof mount; (d) Space available—length and width of property; (e) Antenna—type, manufacturer and model number, square ft.-area of antenna; (f) Transmission line—manufacturer and model number, diameter in inches; (g) Are elevated guy points required? How many, and at what height? (h) Wind load design—Zone A, B, C and ice load, if any; (i) Length of side arms and placement on tower; (j) Any other information you may feel is necessary for special installations, such as type of soil (rock, swamp, sand, etc.)

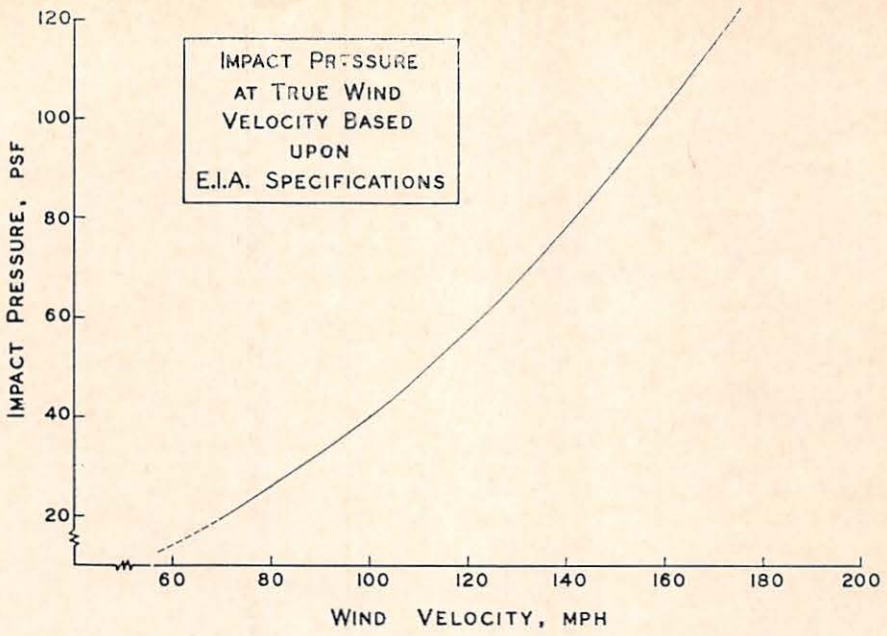
On item (h) of the above, we refer to the EIA specifications for wind load. An example from the chart: A tower designed for 86.6 mph true wind velocity would be a 30 psf wind load tower. A round member is far more desirable than an angular, flat surface tower, due to the lesser amount of wind load on the structure.

The following examples are given as a cost approximation of a typical 100 ft guyed tower and a typical 100 ft self-supporting tower. In both cases the antenna load is a Decibel Products model DB-224, which has a frequency range of 148 to 174 MHz, has 3 sq ft of area, and weighs approximately 32 lb. Both towers are designed for a 30 psf wind load, or 86.6 mph true wind velocity. All conditions are normal. The guyed tower example is a Rohn model 25G, and the self-supporting tower is a Rohn model SSV series.

Guyed Tower.

Material list:

1—BPC-25G base plate
1—¾" x 12" base bolt
9—25G 10' tower sections
1—25AG-2 top section
3—GA25G guy brackets
3—GAC-25-3 guy anchors and equalizer plates
9—⅜" x 6" eye and eye turnbuckles
18—¼" thimbles
1100'—$^{3}/_{16}$" H.S. Guy wire
54—$^{3}/_{16}$"cable clamps



TRUE WIND VELOCITY, MPH	IMPACT PRESSURE, LBS./SQ.FT.
70	19.6
70.7	**20.0**
75	22.5
80	25.6
85	28.9
86.6	**30.0**
90	32.4
95	36.1
100	**40.0**
105	44.1
110	48.4
111.8	**50.0**
115	52.9
120	57.6
122.5	**60.0**
125	62.5

TRUE WIND VELOCITY, MPH	IMPACT PRESSURE, LBS./SQ.FT.
130	67.6
132.3	**70.0**
135	72.9
140	78.4
141.4	**80.0**
145	84.1
150	**90.0**
155	96.1
158.1	**100.0**
160	102.4
165	108.9
165.8	**110.0**
170	115.6
173.2	**120.0**
175	122.5

Approximate cost of the above 100 ft guyed tower:

Tower material cost	$325.00
Foundation cost	200.00
Erection cost	400.00
Total cost	$935.00

Self-supporting Tower.

Material list:

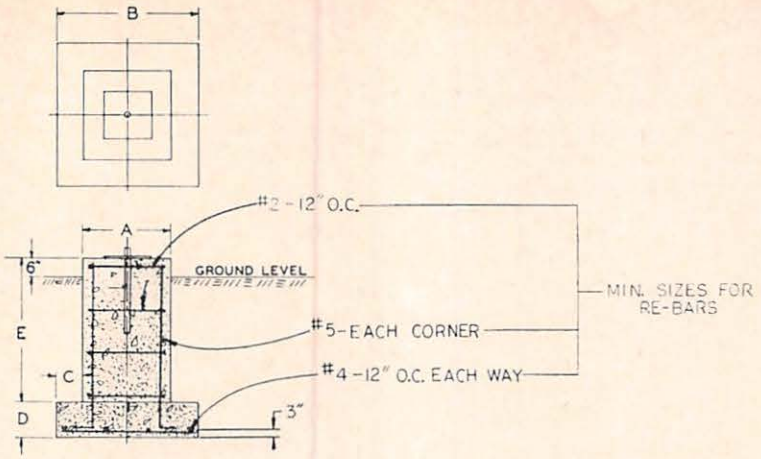
1 ROHN Model SSV-100 complete

Approximate cost of above 100 ft self-supporting tower:

Tower material cost	$ 691.00
Foundation cost	400.00
Erection cost	600.00
Total cost	$1691.00

Antenna Loading. The greatest enemy of any tower is wind. Wind acts on a tower in two ways: directly on the tower structure and indirectly through the antenna.

The force that is exerted on the tower by wind indirectly through the antenna and transmission line is directly proportional to the amount of exposed surface area of all antennas and lines mounted on the tower. Thus, antenna loading, or the number and type of antennas and transmission lines mounted on the tower, is an important factor to consider when selecting your tower. The second way wind acts on a tower is by exerting a force directly on the exposed surface area of the tower structure. Towers should be designed for a maximum strength, while presenting a minimum of exposed surface area to the wind. A method for expressing the effect that a given wind has upon a



CONCRETE BASE DETAIL

CONCRETE BASE SCHEDULE

"CB" NO.	DOWNWARD FORCE "F", LBS.	CONCRETE CU. YDS.	CONCRETE LBS.	DOWNWARD FORCE "F_T", LBS.	DIMENSIONS A	B	C	D	E
1	14,040	.52	1,960	16,000	2'-0"	2'-0"	0"	0"	3'-6"
2	21,940	.81	3,060	25,000	2'-6"	2'-6"	0"	0"	3'-6"
3	32,310	.98	3,690	36,000	2'-6"	3'-0"	3"	6"	3'-6"
4	44,060	1.31	4,940	49,000	2'-6"	3'-6"	6"	8"	4'-4"
5	58,260	1.52	5,740	64,000	2'-6"	4'-0"	9"	1'-0"	4'-0"
6	74,180	1.81	6,820	81,000	2'-6"	4'-6"	1'-0"	1'-3"	3'-9"
7	89,640	2.74	10,360	100,000	3'-0"	5'-0"	1'-0"	1'-3"	4'-9"
8	108,980	3.18	12,020	121,000	3'-0"	5'-6"	1'-3"	1'-6"	4'-6"
9	130,130	3.67	13,870	144,000	3'-0"	6'-0"	1'-6"	1'-8"	4'-4"
10	149,980	5.03	19,020	169,000	3'-6"	6'-6"	1'-6"	1'-8"	5'-4"
11	172,610	6.19	23,390	196,000	4'-0"	7'-0"	1'-6"	1'-8"	5'-4"
12	198,050	7.13	26,950	225,000	4'-0"	7'-6"	1'-9"	2'-0"	5'-0"
13	223,500	8.60	32,500	256,000	4'-0"	8'-0"	2'-0"	2'-2"	5'-10"
14	250,520	10.18	38,480	289,000	4'-6"	8'-6"	2'-0"	2'-2"	5'-10"
15	278,990	11.91	45,010	324,000	5'-0"	9'-0"	2'-0"	2'-2"	5'-10"

ABOVE VALUES BASED ON SOIL BEARING PRESSURE OF 4000 POUNDS PER SQUARE FOOT.

Concrete base schedule is shown in Drawing C-610621.

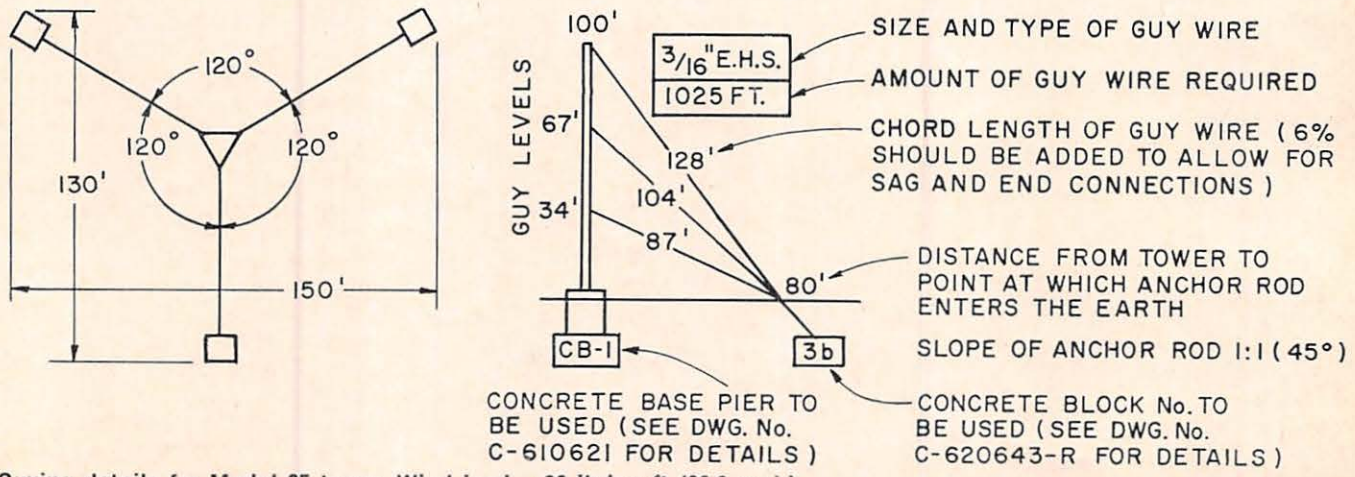
tower is to express the force that this wind exerts on the tower. This force is expressed in pounds per square foot and is called "wind load".

Lighting and Painting. FCC and FAA regulations normally require that any antenna structure tower plus antenna, over 200 ft high must be painted so that it is visible in the daylight and lighted so that it can be seen at night. In addition, a tower, regardless of height, that is to be installed near an airport, must be painted and lighted (Always see FAA rules for certain cases).

Towers requiring painting must be painted throughout the tower height with alternate bands of aviation surface orange and white of equal width, terminating with aviation surface orange at the top and the bottom. The width of the bands must be approximately 1/7 of the height of the structure. This band can be no more than 40 ft and no less than 1.5 ft in width. For tower lighting requirements, consult FAA lighting rules.

Maintenance

A planned maintenance program is a necessity for realizing the full life of the tower. This will not only help maintain the radio system at peak operating efficiency but, of course, is also important for safety reasons. A 6 month planned inspection is recommended, with a two-year program as an absolute minimum. In an area of severe storms, heavy winds, icing, or corrosive atmospheric conditions, more frequent checks are necessary. In those areas where storm seasons have regular cycles, it is recommended that inspections be set up concurrently with these seasons; in areas of severe winters, inspection should be made before and after the winter period. Tower inspections



Guying details for Model 25 tower. Wind load = 30 lb/sq ft (86.6 mph).

should be made by qualified personnel who are able to recognize any defects and provide on-the-spot maintenance service. The following is a general list of items that should be checked when the scheduled inspection is made.

Tower Alignment. By means of a surveyor's transit, determine if the tower is plumb. The tower should be out of alignment by no more than 1" per 100 ft of tower. The tower should be brought back into plumb by adjusting the turnbuckles on the guys. (Caution: Only experienced erectors should attempt this.)

Tower Structure. The tower structure should be checked for bows or kinks, missing or bent members. Bows and kinks are corrected by adjusting guyed tension; however, sometimes splice bolts must be loosened and sections aligned by shaking. Any missing or bent members should be replaced or straightened. (Caution: Only experienced erectors should attempt this.)

Bolt Connections. Check all bolt connections on the tower, and replace any missing bolts or faulty bolts.

Tower Concrete Base. Check the tower base for settling or tilting. This is usually indicated by loose guys or by all tower legs not bearing equally on the base. Check for tilting by placing a level on the pier top. If the base is settled evenly, it is only necessary to tighten the guys; however, if tilting occurs, it will be necessary to grout in the gaps under the base of the tower.

Anchor Movement. Visibly determine if anchor guys are solid and in their original position, or if the anchor has crept out of position. Depending upon the seriousness of the condition, either firm up the earth around the anchor or add reinforcing concrete.

Cable Clips. Tighten all bolts on cable clips, making certain that the side having the nut connection is bearing on the dead end of the guy wire. Replace any clips showing signs of weakness.

Guy Wires. Check all guy wires for broken strands and rusting; replace any guy wires with broken strands. Clean and paint any rusted guy wires with a good rust inhibitive paint. If the guy wire is rusted to the extent that its strength may be impaired, it should be replaced immediately. (Caution: Only experienced erectors should attempt this).

Guy Tension. Guy wires should be retensioned to the proper tension specified in the erection drawings. Slight adjustments may be made with the turnbuckle, but if the slack is too great a cable puller should be used to relieve the turnbuckle while adjustment is being made. Proper tension can be measured by means of a special dynamometer or by the cycling method.

Turnbuckles. Turnbuckles that are rusted should be brushed and painted with primer and finish coat. If the turnbuckle threaded rod is not visible inside the turnbuckle body, the guy should be remade to permit proper turnbuckle adjustment. Locking wires should be looped through turnbuckles after guy adjustments to prevent turning.

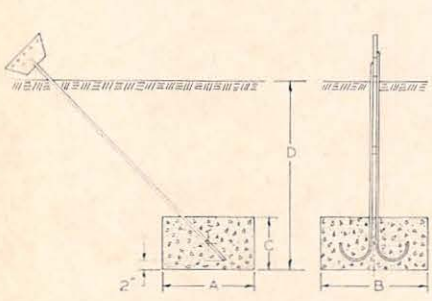
Antennas. Check and tighten all antenna mounting clamps, make certain the antenna is in the correct position, check and tighten all electrical connections.

Antenna Cable. Check all cables to be certain that the line is snug to the tower leg for the entire length of the tower. Smooth any bends or kinks in the cable that could cause shorting. All copper airlines should be checked for leaks.

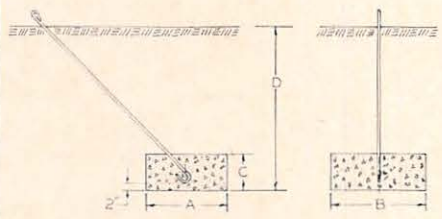
Lighting. Check and replace bulbs, if necessary.

Many factors should be taken into consideration in the location and erection of your tower. One word of caution: The liability factor of your antenna support tower is great; design should always be made by a competent tower manufacturer or a licensed, engineer. It is to your advantage now and in the future, to build your tower to exceed the specifications for what it was originally intended.

Editor's Note: This is the concluding part of a two-part series covering the selection of towers for microwave systems and VHF base radio stations. The microwave tower selection article appeared in RS&C, July 1969, pages 16-21.



ANCHOR DETAIL FOR GAC-34-57-58-59
(FOR GAC-56 SEE DWG. NO. C-620642-R)



ANCHOR DETAIL FOR GAC-25

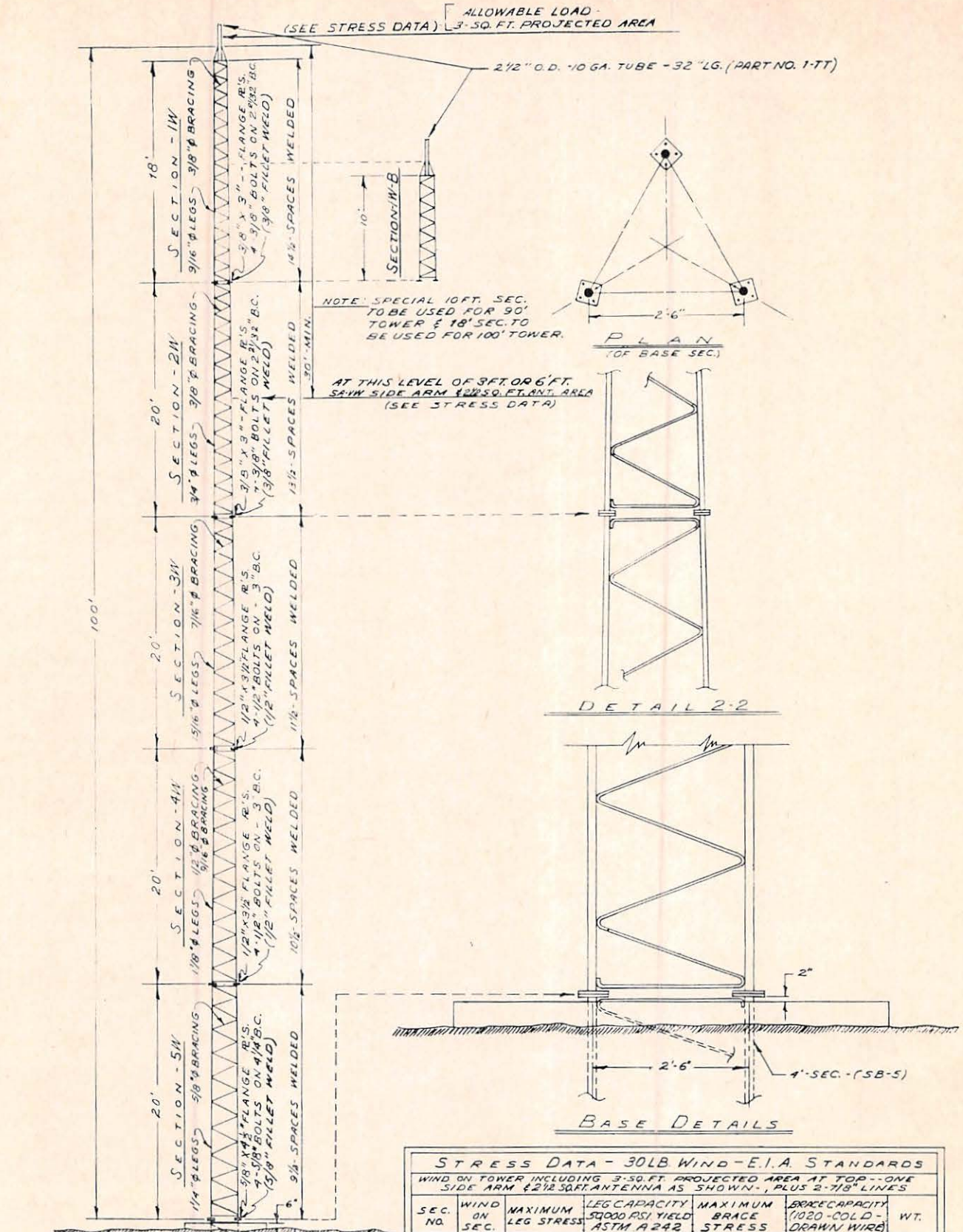
NOTE: REINFORCING RODS ARE RECOMMENDED TO BE USED IN ALL ANCHORS. RODS SHOULD HAVE A MINIMUM DIAMETER OF 1/2" WITH A MAXIMUM SPACING OF 12".

CONCRETE ANCHOR DATA

DEPTH D, FT.	ROD NO.	BLOCK NO.	ANCHOR DIMENSIONS, FT. A	B	C	WEIGHT LBS.	CONCRETE CU. YDS.	HOLDING POWER, LBS.
3	GAC-25	3 a	1.5	1.5	1	310	.08	1,810
		3 b	2	2	1	560	.15	2,640
		3 c	2.5	2.5	1	870	.23	3,630
		3 d	3	3	1	1,260	.33	4,800
		3 e	3	4	1	1,680	.44	6,050
4	GAC-34	4 a	3	3	1.5	1,890	.50	7,000
		4 b	3	4	1.5	2,520	.67	8,500
		4 c	3	5	1.5	3,150	.84	10,400
		4 d	3	6	1.5	3,780	1.00	12,000
		4 e	4	6	1.5	5,050	1.33	15,200
		4 f	5	6	1.5	6,300	1.67	18,300
6	GAC-56	6 a	3	4	1.5	2,520	.67	20,100
		6 b	3	5	1.5	3,150	.84	23,200
		6 c	3	6	1.5	3,780	1.00	26,300
		6 d	4	6	1.5	5,050	1.33	31,700
		6 e	5	6	1.5	6,300	1.67	36,600
8	GAC-57	8 a	3	5	1.5	3,150	.84	44,300
		8 b	3	6	1.5	3,780	1.00	49,400
		8 c	4	6	1.5	5,050	1.33	57,000
		8 d	5	6	1.5	6,300	1.67	64,500
		8 e	6	6	1.5	7,550	2.00	72,100
10	GAC-58	10 a	3	6	1.5	3,780	1.00	83,500
		10 b	4	6	1.5	5,050	1.33	94,100
		10 c	5	6	1.5	6,300	1.67	104,800
		10 d	6	6	1.5	7,550	2.00	115,200
		10 e	6	8	1.5	10,080	2.67	136,400
12	GAC-59	12 a	4	6	1.5	5,050	1.33	144,800
		12 b	5	6	1.5	6,300	1.67	158,700
		12 c	6	6	1.5	7,550	2.00	172,500
		12 d	6	8	1.5	10,080	2.67	200,500
		12 e	8	8	1.5	13,440	3.56	233,200

Concrete anchor details are shown in Drawing C-620643-R.

Please turn the page for a drawing showing the details of a welded 100 ft self-supporting tower.

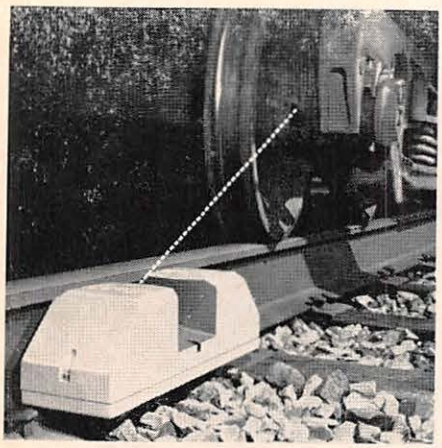


STRESS DATA - 30LB. WIND - E.I.A. STANDARDS						
WIND ON TOWER INCLUDING 3-SQ.FT. PROJECTED AREA AT TOP--ONE SIDE ARM & 2½ SQ.FT. ANTENNA AS SHOWN-, PLUS 2-7/8" LINES						
SEC. NO.	WIND ON SEC.	MAXIMUM LEG STRESS	LEG CAPACITY 50000 PSI YIELD ASTM A 242	MAXIMUM BRACE STRESS	BRACE CAPACITY (1020-COLD-DRAWN WIRE)	WT.
1WA	220	3100	3600	170	700	116
2W	250	7600	7600	286	700	160
3W	180	13000	13000	422	930	230
4W	200	19300	20000	575	1250	335
5W	210	25000	25000	740	1550	435

COMPUTED FACTOR OF SAFETY = 2

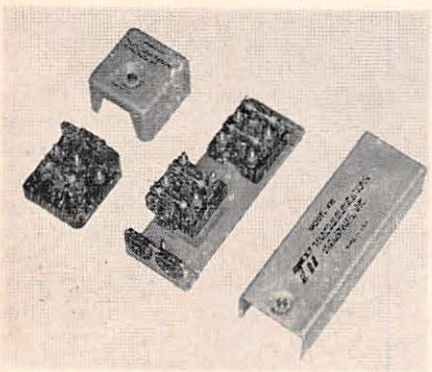
NOTES: LEGS - ASTM A 242 -- BOLTS ASTM A 325
BRACES - 1020 COLD DRAWN STEEL
BASE ASSEMBLY TO BE PERFECTLY LEVEL BEFORE CONCRETE TAKES FINAL SET.
ALL MATERIAL GALVANIZED AFTER FABRICATION

Product News



Hotbox Detector

A new hotbox detector, model 8808, features rail-mounted scanners and solid state all-electronic signal processing. The new detectors will operate with train speeds of from 5 to 150 mph. A new feature of the model 8808 detector is that the scanners are mounted on the rails and "look" at the journal bearing behind the truck frame, scanning the entire journal box in a vertical plane. No special rail anchoring is required and the scanners are clamped to the rails, eliminating any need for drilling of holes or other fastenings. Rail mounting of the scanners will provide for proper alignment between the passing journals and the scanner. The new hotbox detectors differ from previous systems in that former scanners were mounted on ties or separate mountings. Use of solid state electronic equipment in signal processing has cut power consumption one-half, to approximately 500 VA. Both rail signals from the scanners are read out simultaneously. Signals cannot be displaced in time due to skewed trucks, thus eliminating the possibility of false differential alarms. *Servo Corp. of America. Circle 101 on Reader Service Card.*



Protectors

Protection for solid state electronic, communications and telephone equipment against damage from high voltage surges is available with TII 300 "FAILSAFE" gas tube protectors. Designed for indoor or outdoor mounting, TII 300 protectors discharge both sides of the line, and are capable of thousands of operations without requiring replacement. In the event of a sustained over-voltage condition, a fusible spacer actuates a shorting bar which permanently grounds both sides of the line to ground.

The TII 300 is a replacement for carbon block protectors. It does not introduce noise into the line it protects, and it will operate in less than one microsecond and withstands repeated high surge currents. *Telecommunications Industries, Inc. Circle 102 on Reader Service Card.*

● BATTERIES of medium-rate nickel cadmium storage types are included in bulletin AG-414. These pocket plate batteries are particularly suited to those emergency power applications requiring normal current drains for intermediate discharge periods. MDP and MD batteries can be economically applied to inverters for computers, insuring precise voltage-frequency-phase input to the computer. Also, they perform efficiently in DC standby service, such as for telemetry, supervisory control, and alarm circuits. The 4-page brochure includes performance data for both plastic and steel container cell types, in capacities from 13 to 1180 a.h. Discharge characteristics curves are also included. *Nife Inc. Circle 103 on Reader Service Coupon.*

Two-way Radio

A new line of hand-held MASTER Progress Line radios provide 4.5 watts of RF power in the 132-174 MHz band, and 2 watts of RF power in the 406-420 MHz and 450-470 MHz bands.

The 49 cubic inch radio is 8¼" high, 3 7/16" wide, and 1¾" deep. A number of options can be added inside the case and the size of the unit retains the same small dimensions. For example, when any of the operational options such as 2, 3 or 4 frequencies, selective calling tone devices, channel guard or voice operated relay are added, the size does not change.

Crystal discriminator and crystal filters aid interference-free reception. A single conversion circuit results in fewer spurious signals in the set. More than half of the circuits are engineered with integrated thick film hybrid circuit technology. Approximately 70% of the receiver circuit is IC; plus about 40% of the transmitter. The integrated circuit techniques employed permitted optimum circuit design, better uniformity in production and better quality control.

The transmitter and receiver have 12 separate, easily-removed integrated circuit modules replacing more than 200 discrete components. With options, up to 17 integrated circuits replace over 300 discrete components.

One rechargeable 7½-volt nickel-cadmium battery is used for all power requirements and provides more energy per cubic inch than any comparable source currently available. Six C-size alkaline cells may be used without an adapter.

The radio system includes a charging system that prevents over-heating and over-charge. It is designed to accept either a fast or slow charge. The unit can be brought to 70% of its capacity in 15 minutes.

A high/low power switch can extend operating intervals between charges. The high power position extends range; low power increases battery life. In the high power position, when used at EIA duty cycles of 10-10-80%, the GE battery provides 10 hours of operation in high band and 12 hours in UHF. (Based on a 5% transmit, 5% receive and 90% standby duty cycle, over 20 hours per charge is available for high band and UHF.)

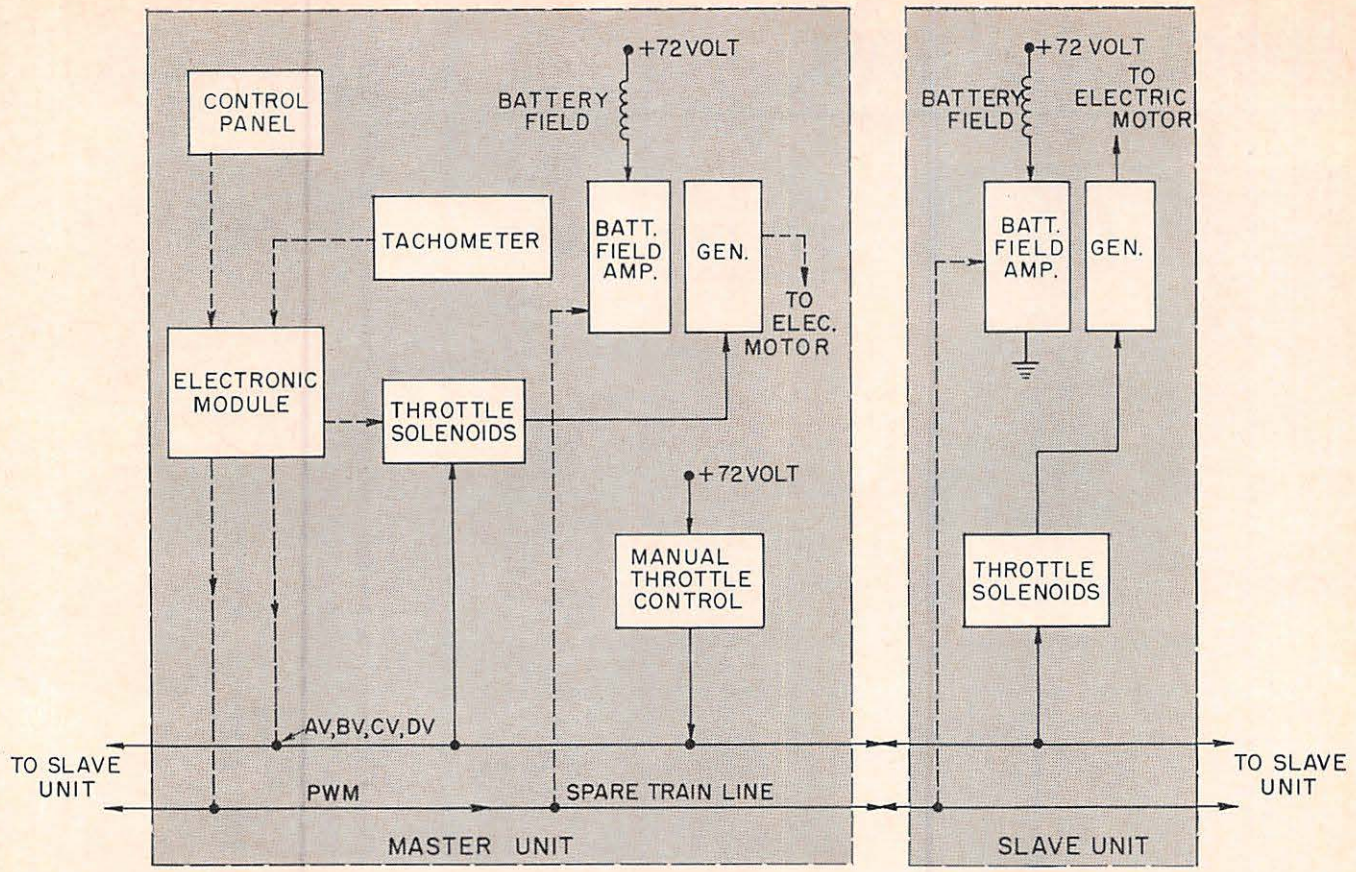
The new line includes an exclusive series of battery chargers, fast chargers, desk charger, vehicular charger and multi-charger. When the battery is inserted, an indicator light shows that the battery is charging. When the light goes out, the battery is charged to 70% of its capacity. At this point, the charger automatically switches to a trickle-charge mode to complete the charging cycle at a slow, safe rate. Even at the 70% capacity, the unit may be operated for several hours.

The four vehicular chargers available are for −12 volt, ±12/24 volt, ±48 volt or ±72 volt power supplies. For these chargers, the battery must be left in the unit. The unit locks into the charger to reduce the possibility of theft and to hold the unit securely in place. The same automatic trickle charge feature is provided in all four vehicular chargers.

The multi-unit charger may be operated as an 8 unit charger or two slave units may be connected to a master giving a total of 24 charging positions. Each position is equipped with an indicator lamp and an automatic trickle switch. All multi-chargers may be either desk or wall mounted.

General Electric has indexed over two hundred internal variations in the MASTR Progress Line personal series

(Please turn to page 32)



Typical arrangement for multiple unit operation with system components mounted on every unit in the consist.

How to control hump locomotives

By Charles E. Stipancic
Manager, Market Research and Product Planning
Signal & Communications Division, WABCO

Hump locomotive speed control increases the throughput of a classification yard. Humping rate is a major factor in determining maximum throughput—the ultimate goal for the class yard complex. In order to approach the full capability of the yard, consistent humping speed must be maintained to provide maximum humping rate and minimize misroutings due to catch up.

Asking a locomotive engineer to hump his train at the most maximum allowable speed irrespective of load changes is requesting practically an impossible task. Considering his response time and the conventional speed sensing tools he has at his disposal, it isn't any wonder the humping rate is either too fast or too slow, but never just right, for yard conditions.

The hump locomotive speed control system has been installed at a classification yard in the mid west. It automatically maintains desired speed selections for hump locomotives when used in humping operations. Trains with wide ranges of variable load conditions can be pushed over the hump at selected speeds with precise control. Accuracy of speed regulation is within 0.1 mph in the range of 1 to 5 mph. Locomotive speeds can be controlled in the "manual" mode from the engineman's control panel, or speeds can also be selected and controlled automatically by radio remote from the crest tower.

At this yard, the hump locomotive speed regulation system is interfaced with a radio cab signal system. Both systems utilize the same RF carrier link. The humpmaster can transmit various combinations of cab signal indications to a total of four locomotives or speed command signals for speed regulation to a total of two master locomotives. With cab signaling, the engineman has the advantage of being able to receive yard movement instructions, from the crest tower by observing cab signal indications.

Humping efficiency at this yard, has been significantly increased with the use of speed regulation. An average time saving of approximately 20 min. is realized for every 150-car train that is humped over the crest. When 18 trains a day are humped over the twin track crest, the humping chore can be reduced by approximately 6 hr.

When a train approaches the hump on either of the twin tracks, the humpmaster can request remote control from his console and select the desired humping speed without stopping the train.

To illustrate the flexibility of control, let's take a train up the hump lead. A train is entering the approach track circuit below the hump at 3 mph on a green cab signal. A bell in the tower is actuated to indicate the position of the train, and simultaneously, the cab signal indicator in the locomotive automatically goes to yellow. The engineman places the throttle

Editor's Note: Abstract of a paper presented at the Eastern Sectional Meeting, Communication & Signal Section, AAR, at Alexandria, Va., May 14, 1969.

in notch "1" and the panel mode selector switch on "automatic". The locomotive controls are now in their proper positions for remote control. The humpmaster in the crest tower positions his speed selector switch on the console for 1 mph. He then pulls the associated pull switch, which causes audio frequencies to be transmitted to the locomotive radio receiver, via RF carrier link. The amber pushbutton indicator on the locomotive control panel starts to flash. This indicates a request from the tower for remote control operation. The engineman than presses the flashing amber pushbutton indicator on his panel, which activates control equipment and gives the tower automatic control of the locomotive. The locomotive may then be controlled from the humpmaster's console at any one of the seven hump slow speeds.

When in the remote control mode, the engineman monitors the operating control over the locomotive. At any time, he may regain manual control by manipulating the proper locomotive control levers. Again, the yellow cab signal aspect will glow and the amber indicator on the panel will flash, indicating a request for automatic operation. In other words, the engineman is being requested again for automatic operation of the locomotive control. Remote control operation may be restored by returning the locomotive control levers to the proper positions and pressing the amber pushbutton indicator.

The hump conductor can request a return to manual operation by transmitting a stop command. Braking will then be initiated automatically and the brakes will stay applied until the engineman manually assumes control of the locomotive by moving the proper control lever. Regardless of any additional commands transmitted later by the hump conductor, after transmitting a stop command, the brakes will stay applied until the engineman resumes control of the locomotive.

If desired, the system can also be operated without the radio link, known as the automatic "on-board" mode of operation. The engineman must again place all his locomotive controls in the proper position and press a blue pushbutton indicator on his panel. This will cause the indicator to glow which indicates that local automatic control is in effect. The engineman then selects the desired speeds by rotating the speed selector switch on the panel. Speeds of 1 to 5 mph can be regulated from the engineman's control panel.

Should the engineman move the throttle controls from their proper position, the locomotive will automatically drop out of the "automatic" mode. To resume automatic operation again, the throttle controls will have to be returned to their defined positions. However brakes can be applied, the train stopped and held, and when brakes are released automatic operation will resume.

The components of the Hump Locomotive Speed Regulation system are control panel, electronic module, battery field amplifier, and tachometer generator. The control panel contains various controls for speed selection, mode selection, pushbutton indicators, and a speedometer. The electronic module is the main component in the speed regulation system. It contains electronic circuitry which receives and generates the power signals for controlling the system. The primary function of the battery field amplifier is to regulate the current through the battery field of the main generator. A tachometer generator, mounted on the axle of the locomotive, provides pulses at frequencies which are proportional to the actual speed of the locomotive. The vehicle control box contains tone modules and radio receiver. This is required when speed regulation is used with a radio remote control system.

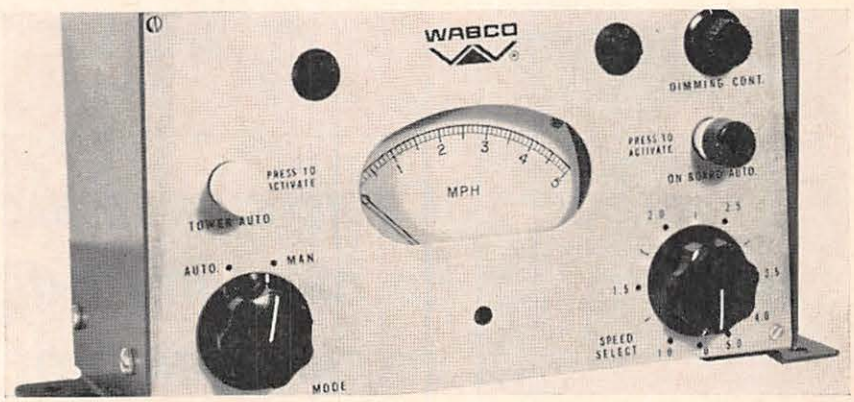
This automatic system can be interfaced with the conventional electrical controls of most standard American-made diesel-electric locomotives that are equipped with an eight-step throttle control system and DC excitation of main generator. Automatic speed regulation on a locomotive is achieved by programming signals on the throttle solenoid trainlines for coarse power control and by modulating current through the battery field on the main generator for fine power control.

System components are designed so that applications can be made for "single" or "multiple" locomotive operations with minimum disruption of equipment and without any change to the original manual controls in the locomotive cab. Remote control equipment can be interfaced with any system arrangement to meet particular requirements.

There are two application versions of this system—one involves equipment on master and slave units, the other on master units only. The equipment required on the master and slave units includes control panel, tachometer, battery field amplifier, and electronic control module. Each slave unit is equipped with its own controlling battery field amplifier for fine power control, which is similar to the master locomotive. A pulse width modulated signal controls both the master and slave locomotive battery field amplifier via trainline connections which in most cases are now available as spares.

Therefore the master and slave locomotives are programmed in the same throttle positions and they notch up and down automatically in the same manner. Both provide coarse and fine power control. The advantage of this application is there are no restrictions on the mix of power within the locomotive consist. Further, up to seven slaves can be controlled by one master unit.

The other version is for those that do not desire to equip each slave unit and are willing to accept certain operating restrictions. They are: the master unit should be capable of delivering more horsepower than any of the individual slaves, and the maximum number of slaves is limited to three. When these rules are followed, this system will provide the same accuracy as the one previously described. If under operating conditions, the rules are not adhered to, the system accuracy will be affected. This will be observed mostly at the start of the humping operation and possibly as the last dozen or so cars are pushed over the hump. The advantage of this application is that only the master unit need be equipped, and, when conditions arise that additional power is required to hump the train, other slaves can be added with no modifications or equipment additions.



Cab-mounted automatic and manual control unit.

Cable systems: advantages for rrs

By Herbert H. Schenck
Executive Vice-President,
U.S. Underseas Cable Corp.

In considering cable systems there are four worthy features:

- Outstanding performance and reliability
- Minimum maintenance
- Great flexibility and versatility, and
- All the capacity and capability you need now, and tomorrow.

As for system performance, excellence here manifests itself in a number of ways. Most important, coaxial cable communications systems can be made error free almost to the degree beyond the ability of test equipment to measure. This is particularly vital in data transmission, where transposition and other errors can be a serious matter. And cable has outstanding ability and virtually unlimited capacity to pass data. Another important point is that cable systems are engineered to be unaffected by changes in the weather. Rain or shine, whatever the cable system is called upon to provide, it does . . . flawlessly.

PERFORMANCE STANDARDS

We're all accustomed to think in terms of well-established standards of transmission performance, either our own, or Bell System, or the recommendations of CCITT. These standards cover such things as end-to-end net loss, distortion, crosstalk, noise—and now more and more attention is focused on envelope delay or better named, delay distortion. I can say positively that any of the existing standards are easily met by land cable systems, and go one step further—if there are exceptional requirements, it's a good bet that a land cable system can be designed to meet them.

Cable systems are intrinsically reliable, and if undisturbed, hardly anything can go wrong. The electronic components are all proven equipment, designed for a long, trouble-free life without any wayward or temperamental characteristics. Reliability is intertwined with low maintenance requirements. Once installed, a cable system is as free from maintenance problems and expenses as any communications system can be. Another point should be mentioned here, too, which relates to both reliability and maintenance: a coaxial cable system is generally 100% in or in those hopefully rare cases, 100% out of service. The infrequent disruptions incline to be total and are easily traced to their source.

For years, and even today, pressurization has been resorted to, to raise the service reliability of cables. The modern composite cables can be pressurized too. They can be armored, with steel wire or steel tape; they can be required to be placed in conduits, and protected with a foot of concrete poured over the top. But I suggest to you that acceptable orders of reliability can be achieved without these costly additions, and venture to forecast that the future points to direct burial of unarmored plastic-sheathed cables as offering far and away the best engineering solution. Don't misunderstand me, certainly there are situations in which we would recommend extreme protective measures, but by and large, we will see less and less conduit, less and less armor, and less and less pressurization.

Inductive coordination, and protection from power faults and lightning are vitally important to any buried plant, power or communications. Fortunately there is a large body of information on this important subject, and naturally the most effective possible treatment would be used in engineering a new land cable project.

The particular effect of power system faults on communications plant arises from the zero-sequence currents flowing into the fault, with two results: rise in earth potential, and the mutual induction of unwanted potentials in paralleling circuits. What happens is that the protective devises installed to relieve the communication apparatus of unwanted voltage stresses will operate. But sometimes the protective devices would fail to operate, or in operating, would themselves fault the communications circuits.

Now the magnitude of the stresses confronting communications plant is a function of the magnitude of the zero sequence currents. This depends on several things: The zero sequence impedance of the power line from source to fault, and the amount of "moxie" the power system is capable of pouring into that fault. The larger the power line conductors, the lower the zero sequence impedance, and consequently the higher the fault current. This results in higher earth potential rise and higher induction. The higher the voltage of the power line, the greater will be the surge of current to the fault, and so on. What I'm saying is that while a very large power cable can cause considerable havoc if it faults, power cables of modest purposes will have lesser and lesser effect. And in any case, the communications cable system can be designed to withstand it.

Put it this way: unless the principal use of a trench or a side of a right-of-way is the transmission of large quantities of power, I see no reason why communications cables and power cables can't exist side by side, with the particulars of the case determining sheath insulation values, ground conductor requirements, and protective devices.

All that I've just said about power faults applies to lightning protection as well. A lightning hit anywhere around insulated plant—power or communications—will stress the insulation through rise in earth potential. Of course a direct hit on your conductors are understandably less than in the case of aerial plant.

Cable systems can be designed to meet immediate and future requirements of the user.

Cable is enormously versatile. The question of "What kind and how much information and data and signaling functions can we provide by cable?" can only be answered by another question: "What do you need?" Any quantity and type of data, signalling, closed circuit television, scores of voice circuits, monitoring—it can all be handled by cable. Cable can feed 100% accurate data to your computer—serve as a telephone communications medium of unequalled clarity, and simulataneously perform your signaling requirements.

In terms of capacity and reliability, these systems can be designed to meet the immediate and future requirements of the user as far forward in the future as you may wish to plan. There are, of course, cable carrier systems that use unloaded or carrier-loaded physical pairs, and for modest requirements over relatively short distances, such facilities are usable for railroad service. But there are limitations to this class of facility that would argue against them in plans for new installations. We should look toward the coaxial systems today and in the future.

Physically, the composite cable will have two or more coaxial tubes of the conventional sizes—0.25," or 0.175," or 0.375"—plus a requisite number of physical copper pairs with the gauge determined by the requirements of transmission, for handling the track-side items that occur along the route.

The repeater spacing along the right of way is a function of the coaxial size and the amount of bandwidth required, which in turn determines the top transmission frequency.

200 MILE SYSTEM

Let's consider a hypothetical system involving an initial requirement for say 60 duplex voice channels involving both end-to-end and intermediate communications such as 600 signalling functions, 133 track-side party line telephones, 20 automatic block control circuits, 14 agents telephones, and 5 dispatcher base radio stations, along a track segment approximating 200 miles.

We would visualize the use of a composite cable with two coaxial tubes for long-haul voice, data and future broad band circuits, and 25 pairs to be used for along-track signaling, switching and communications.

The cable would be buried along the right-of-way at a depth of approximately 4 ft. to reduce the chance of damage from derailment and other possible hazards resulting from right-of-way maintenance, construction, etc. For this system, repeaters would be spaced approximately 5 miles apart and placed in the ground or above ground. In either case they would be accessible for maintenance if required.

A wide variety of enclosures are available, even including some suitable for continuous submersion. Repeater housings can be pedestal-mounted, pit-installed or even direct-buried. The nature of the housing can be adapted to the needs of the project.

Cable carrier equipment is transistorized.

The system would be powered from both ends with the power feed equipment being an integral part of the system, and would include the capability to operate the system for approximately 8 hr. in the event the external power sources should fail. The repeaters are energized by a series direct current in the coaxial's center conductor. The power feed system is essentially a constant-current device, with the impressed voltage adjusted for variations in conductor resistance and swings in earth potential.

In terms of intermediate drops for way-side telephones, signaling, etc., we use the repeater location as a point of departure for these requirements, using our 25 pairs for this purpose. Since these points are only five miles apart, distances to the equipment interface points are minimum. Besides, there are a variety of well-developed splice-cases for obtaining access to the physical pairs without opening the coaxial tubes, at points anywhere along the cable.

A projection from the present 60 channels through 300 channels is easy to make. To meet this expansion would require only terminal equipment. The cable and repeaters would remain untouched. But suppose 300 were not enough? Let's raise our requirements to 960 channels, what then? In such a case it would be necessary to reduce the repeater spacing and introduce additional repeaters. Also, of course, additional terminal gear will be required.

Incidentally, there's absolutely nothing impossible about placing a modern composite cable up in the air, provided you've got poles or towers that have to stay there for other reasons. But by and large, I think you'd be better off in the ground. Risk the gophers in preference to the hunters. And depending on at least a half-dozen considerations, the cable can be placed either in an opened trench or plowed right into the ground. Another aspect which may have come to your mind is that of simultaneously burying the composite cable with other types of cable such as power. Techniques available today actually permit simultaneously burying the composite cable with other types of cable such as power.

In terms of our hypothetical 200 mile system with buried cable to include providing the various equipments for signaling, telephones, dispatcher radio stations, etc., we would estimate that the costs would be approximately $195 per channel mile for 60 channels; reducing incrementally down to $45 per channel mile for a 300 channel system. Naturally this is an estimate and, of course, there are some assumptions in it. But by and large we believe it to be realistic and conservative.

MAINTENANCE COST

Of almost equal interest with plant first cost goes plant maintenance cost. Let me say a few things about buried coaxial cable. Cable is at home in the earth. Cable doesn't wear out in the earth. Sunlight doesn't reach it. Hunters don't see it. Wind can't move it. Cars and trucks can't touch it. Ice doesn't bother it. Rain or snow are undetected by it. Kites don't find it. Of course bulldozers, trenchers, and back-hoes are all notoriously good cable-finders, but then, it's up to someone to keep 'em off the right of way.

Then what about the electronics? Cable carrier equipment today is transistorized. This means simply that there isn't any inherent depletion or degradation from burn-out or wear-out. Trouble-shooting is simple and easy. Your present level of testmen and linemen can learn to look after it.

Let me now highlight some of the specifics we have discussed. First . . . as an objective . . . cable will provide a total communications and signalling system. In the case we have been discussing it would be composite underground cable, unrestricted in flexibility with a capability of 300 4-kHz duplex channels which could be expanded to 960. Ease of maintenance is assured by its easy accessibility and low cost. It will interface with existing systems now in operation as required, and in terms of system power, it is self-contained.

Data Modem Characteristics

Manufacturer	Sangamo Electric	Sangamo Electric
Model	T202C5, C6	T202C7, C8
Transmit and/or receive	Transmit & receive	Transmit & receive
Full and/or Half Duplex	Full or half duplex	Full or half duplex
Dial up or Private Line Application	Private line or DDD	Private line or DDD
Turn around time (HDX)	—	—
Automatic answer capability	Internal	Internal
Type modulation	FM	FM
Operating Frequencies	Mark 1200 Hz	Mark 1200 Hz
	Space 2200 HZ	Space 2200 Hz
Clock, internal or external	External	External
Loop back testing feature	Yes	Yes
Error rate	—	—
Error detection and/or correction	No	No
EIA RS-232-B interface	RS-232-B	RS-232-B
Bit or character rate	0-1800 bits/sec	0-1800 bits/sec
Serial or parallel transmission	Serial	Serial
Impedance to line, ohms	600 or 900	600 or 900
Impedance to data equipment, ohms	RS-232-B	RS-232-B
Voltages to and from data equipment	—	—
Frequency stability	—	—
Level stability	—	—
Output levels to line, dbm	—	—
Input levels, from line, dbm	—	—
Line requirements, frequency response	DDD- 1200 bits/sec	DDD- 1200 bits/sec
	3002 C1- 1400 bits/sec	3002 C1- 1400 bits/sec
	3002 C2- 1800 bits/sec	3002 C2- 1800 bits/sec
Line requirements, envelope delay	ditto	ditto
Line requirements, impedeance	ditto	ditto
Line requirements, signal to steady noise	ditto	ditto
Line requirements, signal to impulse noise	ditto	ditto
Method of operation	2 or 4 wire	2 or 4 wire
Temperature and humidity limits	—	—
Power requirements	117 or 235 volts	117 or 235 volts
	47-63 Hz	47-63 Hz
Dimensions and weight	—	—
Digital or analog	Digital	Digital

WABCO's new 3R Railroad Radio is Rugged, Reliable, and Ready

And we mean always *ready*. For one thing, the 3R is all solid state. All transistors used in the 3R are silicon types for improved operation at high temperature. 3,000-volt transient protection insures uninterrupted performance. And it's RUGGED. Cast aluminum chassis. Strong sheet steel outer cover. *Designed* and *built* for rugged service. We know it's rugged, because we've tested the new 3R in the lab and under tough field conditions for over a year.

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Audio Power .....8 Watts
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Crystal Selectively Filter
Field Effect Transistors
Instant on-frequency performance-crystal elements without heaters

For Superior Reliability

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Power Sensor and Level Control to protect transmitter
Transmitter control timer standard on all railroad units

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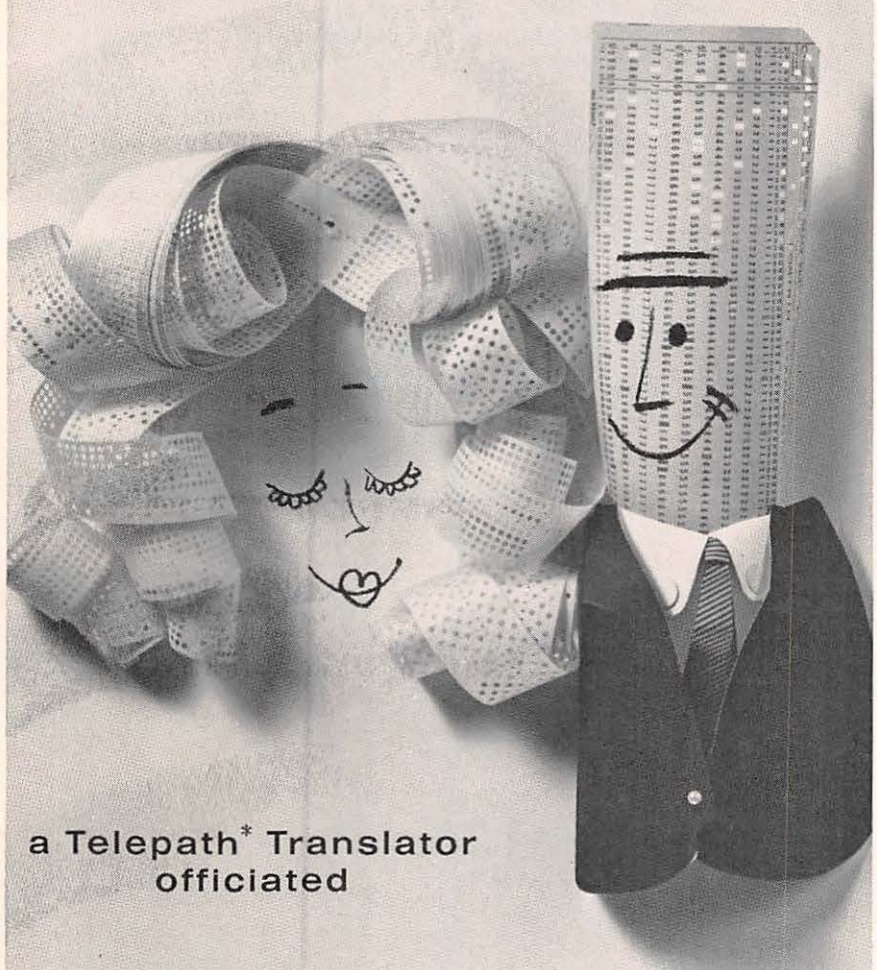
Sally TWX married Mr. P. Card



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PRODUCT NEWS

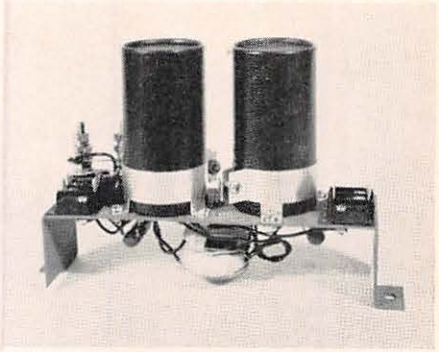
(Continued from page 25)

radio (excluding frequency variations) to give flexibility. Three control systems are available—internal, internal/external or voice operated circuits. They may be equipped with transmitter audio compression. All controls except the push-to-talk switch and the high-low power switch are mounted on the top surface of the unit.

A belt clip is supplied with each unit and may be attached to the back of the radio if desired. A threaded insert on one side of the unit is designed for easy installation of a carrying strap. A leather case and shoulder strap may be used to free hands for other operations.

Accessory options include remote speaker-microphones, lapel microphones, high noise headsets, miniature headsets, earpieces and lapel speakers. The standard antenna can be replaced with a solid whip antenna, a flexible wire antenna or a spring whip antenna. To add ease and speed to checking the unit out there are test fixtures and cables, IF generators, test amplifiers and probes, charger calibrators and test adapters. *General Electric Mobile Radio Department, Circle 104 on Reader Service Card.*

● TOWERS and passive repeaters are described in brochure C-269. Also included are descriptions of facilities and engineering and field services available for the design and construction of microwave systems. *Microflect Co., Inc. Circle 105 on Reader Service Card.*



Power Filters

A new DC power filter affords protection from lightning, high line voltage surges, and surges from electromagnetic devices. Combined with standard lightning arresters, the filter provides optimum protection for overlay track circuits, carrier, and other battery-operated electronic equipment.

The compact unit mounts either in a type B relay mounting space or directly on a wooden surface. Two or more units may be parallel to accommodate loads larger than the rating.

Basic specifications are: Input voltage—5 to 35 volts DC; Output current—up to 2 amp; Ambient temperature range —40 to +160 deg. F; DC resistance to ground—approximately 30,000 ohms. *General Railway Signal Co. Circle 106 on Reader Service Card.*

Railway Cybernetics

SRI reports on expanding teleprocessing

Stanford Research Institute's study of replies from nearly 70 organizations to the Federal communications commission's inquiry into "regulatory and policy problems presented by the interdependence of computer and communications services and facilities" has been released.

SRI said: "If teleprocessing continues to expand at the rates that have been experienced in the last five years, a serious discrepancy could develop between the capability of the carriers to supply data services and the demand for these services. To some extent, the more efficient use of telephone circuits may limit the need for new construction. However, the need for technical personnel trained in data communications, both in the data processing industry and in the communications industry, could become a limiting factor on growth. It is also possible that some of the carriers would become capital-limited during these coming years of growth.

"What appears to be most needed in order to avoid serious shortages of personnel, capital, and management during the next decade is careful planning and forecasting. Such planning can be accomplished most effectively by both industries working together with representatives of the Commission and state regulatory agencies. Planning for new services, growth of existing services, and changing technical standards is needed both on a federal and state level. The Commission could encourage carrier participation in this process through the allocation of some of its resources to continued planning and monitoring in cooperation with the teleprocessing industry."

FCC noted that "The most notable regulatory problem raised by the respondents (to the computer notice of inquiry) and discussed by SRI in its study arises out of the rendition of data processing services by common carriers, and the provision of what are claimed to be communications services by unregulated data processing organizations.

"There does not appear to be any public need or demand for regulation of what is generally understood to constitute data processing. However, serious differences arise over what to do when data processing is part and parcel of a mixed offering which includes communications type functions, most notably message switching.

"We believe it would be best, however, to obtain more information regarding present and future needs and the technical, operational, and economic implications involved in meeting those needs. Until we have given further analysis to the problem, we are leaving open for the time being the question of specific regulatory or other actions which might be usefully taken to assure privacy and security of data."

FCC said that responses to its inquiry and the SRI study emphasized that there are "an increasing number of technological problems relating to the adequacy of existing communications facilities to meet the needs of the growing computer technology.

"Thus, they raise questions as to the need for a digital transmission network designed specifically for data communications requirements, the need for greater transmission speed and accuracy, the need for greater variety of bandwidth configurations, the need for more sophisticated equipment to assure security of data, and the need for development of domestic satellite networks for data communications requirements and many others. Although the data produced by the computer inquiry and the SRI study provide a most valuable point of departure, more definitive and comprehensive technical data relative to these needs must be developed.

"There is considerable complaint regarding the three-minute minimum rate schedule applicable to message toll telephone service. Because large volumes of data can be transmitted over the switched network in bursts which consume seconds rather than minutes, the three-minute minimum is regarded as uneconomical." Noting AT&T's plan to introduce a one-minute minimum trial, the FCC observed that "The offering will be available to both voice and data users of the switched network at substantial savings."

SRI said "Many of the problems that appeared most serious two years ago have since been resolved by the actions of the carriers. A number of important issues, however, have not been fully resolved.

"These remaining issues can be considered in four main categories, as follows: (1) the conditions under which various classes of equipment provided by the data processing industry can be attached to the telephone network and the limitations on the classes of services that can be offered by non-carriers;

"(2) The extent to which the carriers will be allowed to offer data processing services in competition with the data processing industry; (3) the extent to which the carriers can be expected to provide new data-oriented network services at a

(Please turn to page 36)

View from the Crossarm

● *The Oscilloscope.* A completely rewritten, updated edition includes triggered sweeps, dual-trace scopes, electronic switches for multi-waveform displays, DC-to DC supplies, DC-to-AC inverters and DC-to-DC converters.

The author covers basic waveforms (DC sine, sawtooth, trapezoid and pulse) clearly detailing their generic characteristics and how they are interpreted in oscillography. Scope operation, from the CRT screen to the power supply, is thoroughly explained.

Chapter 5 shows how valuable the scope is in radio and TV alignment. Further tests and measurements are given in later chapters—audio measurements, power output calculations, video, hum, current, plus special oscilloscope techniques, probes, etc.

Included in the final chapter are 17 step-by-step procedures specifically planned for familiarization with the methods for performing tests and measurements with an oscilloscope. Here the reader will find information needed to make comparisons of direct and simplified signals, detect audio signal distortion, observe transmitter modulation percentage, employ square-wave response tests, perform capacitor leakage measurements, set up dual-trace displays, analyze and interpret various waveforms, understand and use various probes. *The Oscilloscope, 3rd Edition, by George Zwick, 256 pages, TAB Books (No. 498) Price: $7.95 hardbound; $4.95 paper.*

● *Reference Data for Radio Engineers* is a new compilation of approximately 1150 pages and 1350 illustrations plus a comprehensive index and cross-index directed by the International Telephone & Telegraph Corp. staff. In 45 chapters of a brand new format, 50% of the text is new material, including seven subject areas not covered by the fourth edition. In addition to the basic phases of electronics, there is new material on microminiature electronics, space communications, navigation aids, quantum electronics and many other current topics.

The text is supplemented with hundreds of charts, nomographs, diagrams, tables, circuit information, illustrations and an inexhaustible index and cross-index. *Reference Data for Radio Engineers, 5th Edition, H. P. Westman technical publications editor, and Melvin Karsh, associate editor, Howard W. Sams & Co., Inc., 1150 pages, Price: $20.00.*

News Briefs

● Canadian National's signalmen are spending more time in classrooms. There was a time when signalmen went back to school for refresher courses, and to learn new techniques, about three days every six months. Now, the basic course involves 43 days of instruction spread over two years.

The basic structure of the training program was changed with the coming of centralized traffic control signals, automatic car identification and future aspects of the Traffic Recording and Control System (TRACS).

Signal maintainers now go back to school in sessions of five days, 22 days and two 8-day periods. On completion of the basic course they become qualified signal maintainer mechanics.

A new course leading to the title Electronic Technician is now being prepared and will be introduced soon. This course will consider the maintenance problems of ACI scanners. Another aspect of the TRACS program dealt with in the new electronics course is a Terminal Car Control system, now being introduced in CN yards across Canada.

On the Great Lakes region, covering most of Ontario, a permanent classroom and fully-equipped instruction car have been pressed into service, where students study the actual working components of equipment such as highway crossing signals, colorlight block and CTC signals, and power switches.

● ASSOCIATION OF AMERICAN RAILROADS took exception to FCC Common Carrier Bureau Chief Bernard Strassburg's report and requested that the Commission reopen the record in its Telpak sharing case. AAR also urged the Commission to designate new procedures to handle such cases. AAR said that Chief Strassburg's recommended decision "finally demonstrates, as the arguments of the parties heretofore apparently failed to do, that the Telpak sharing case cannot be decided in a vacuum . . . Since Telpak sharing is, essentially, a pricing system, it is likely that the question of different rates for different classes of customers can only logically be explored" in the separate Telpak/private line docket, in which hear-

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ings have been deferred.

AAR said it "recognizes the fact that the bureau Chief completely failed to make any findings of fact whatsoever on the effect of sharing and, more importantly, the effect which a change in the sharing provisions would have—on the railroad industry is properly a subject for exceptions in this case." But, it said, facts regarding the extra-record matters referred to in the recommended decision should be explored in an evidentiary hearing, so reported *Telecommunications Reports.*

● MISSOURI PACIFIC is now in the process of improving its total communications network including expansion of Telpak and leased lines, upgrading of company owned wire lines and addition of long distance telephone service in low density areas. A new system-wide data network using telephone circuits and capable of transmitting data from 60 to 3200 wpm will be installed which will cover the road's operations and administrative work, as well as serving customer service centers. Additionally, expanded radio communications will enable road crews, maintenance-of-way crews and mobile agencies to check with dispatchers and telephone operators along MP tracks.

● NEW YORK CITY TRANSIT AUTHORITY has awarded a contract for more than $3 million for 1,100 two-way radios to be purchased from General Electric Co. The radios will be for use on the BMT and IND lines. A total of 980 portable units will be installed in subway train cabs and an additional 100 portable units will be used by NYCTA police, supervisors and maintenance personnel. Twenty-two base stations will be furnished by GE for use by dispatchers and administrative personnel to contact motormen and police.

● NORFOLK & WESTERN will spend $2.9 million for modernizing its classification yards at Shaffers Crossing, near Roanoke, Va. The program will include the installation of radar speed control, digital computer-controlled automatic route switching, modern pneumatic car retarders, an air compressor system to operate retarders and switches, and a new building to house the retarder control equipment. Modernizing of the 55-track classification yard will begin shortly. A major goal is to increase retarder capacity to handle 160-ton cars.

● MISSOURI PACIFIC ordered 187 radio units for road train service from Motorola Communications & Electronics Inc.

● MONONGAHELA has signed a series of contracts with Syntonic Technology Inc. to provide leasing of and maintenance services for microwave, radio, teletypewriter and two-way voice communications. Installation of this communication equipment, recently completed, provides the railroad with station-to-train and in-yard voice communications over the entire line. STI recently acquired the business and assets of the Communication Services Division of Radiation Service Company, which had been furnishing maintenance services for microwave and other voice communications to several railroad companies.

● RAILROAD SAFETY TASK FORCE, headed by Federal Railroad Administrator, Reginald N. Whitman, has suggested an eight-point railroad safety program—including enactment of legislation. To implement the eight recommendations, the Task Force urged that the Secretary of Transportation draft appropriate legislation in consultation with the Task Force and appropriate Congressional Committees.

Specifically, the Task Force recommended: (1) The Secretary of Transportation, through the Federal Railroad Administration, be given authority "to promulgate reasonable and necessary rules and regulations establishing safety standards in all areas of railroad safety." (2) Establishment of a National Railroad Safety Advisory Committee to advise, consult with and make recommendations to the Secretary. The Committee would be chaired by the Federal Railroad Administrator and have representatives from State regulatory commissions, railroad management and labor. (3) A "Federal-State partnership" in administering a rail safety program, with existing State rail safety statutes and regulations "remaining in force until and unless preempted by Federal regulation." (4) Initiate a Government-industry research program into railroad safety technology funded im-

(Please turn to page 38)

FIELD ENGINEER
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RAILWAY CYBERNETICS

(Continued from page 33)

reasonable cost; (4) the extent to which the carriers and the data processing industry can be expected to provide a reasonable measure of privacy to their customers.

"The principal regulatory alternatives governing classes of teleprocessing services that can be offered by non-carriers are: (1) restrict the provision of some teleprocessing services, such as those that are 'primarily communications,' to carriers; (2) allow free entry into all teleprocessing services that do not cause degradation in the quality of network services to other users of the network."

Also, SRI noted that "low data rate services—at 300 bits per second or below—are likely to continue to account for most of the data traffic and data terminals in use in the next five to eight years. The cost of a telephone circuit is not likely to change much over this time period.

"However, improvements are being made in the capability of telephone circuits to transmit data which could increase the allowable data rate on such circuits by a factor of up to four in the same time period. The allowable data rate on a voice band circuit in the public telephone (switched) network is about 2000 bits per second at the present time.

"Improvements in the technical means for combining data signals before putting them into the network and increasing flexibility of the rules governing sharing and resale of telephone circuits may further significantly lower the effective cost of data communications, especially in the case of low data rate systems.

"Thus, the cost of data communications is in fact rapidly decreasing and might decrease as much as an order of magnitude below its present cost in the low data rate portion of the market during the next eight years. These improvements are very likely to encourage the continued rapid growth of teleprocessing services."

SRI concluded: "An ability to predict outcomes of regulatory action would be valuable in regulatory decision-making. A policy research program that combines research on modeling and simulation of carrier behavior with studies of carrier performance measurement and costs could yield an improved capability for the future.

"Several specific research programs that are suggested by the computer inquiry are: (1) analysis of the market for teleprocessing services over the next decade—a forecasting capability could be developed in cooperation with the data processing industry and the carriers;

"(2) Analysis of carrier performance in data communications—development and application of objective carrier performance indicators could be extremely useful in judging progress in this field;

"(3) Small carrier capabilities in data communications—a study of the needs for data communications in areas served by the smaller carriers and of their probable capability to respond; (4) privacy study—a study of present carrier practices and of the costs of providing increased privacy in the use of communications lines could lead to better policy decisions in the future;

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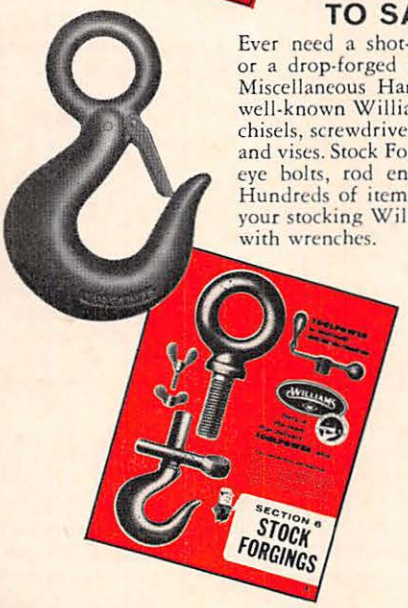

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NEWS BRIEFS

(Continued from page 35)

mediately for an initial three-year period. (5) Expansion of formal employee training programs "to insure compliance with safe operating practices and reducing the impact of human error in the accident experience." (6) An expanded program of grade crossing safety "utilizing established Federal and State agencies and advisory groups to set uniform procedures and standards, "with new sources of funding provided. (7) Federal Railroad Administration should revise its rules for reporting accidents "to make the data more current, more uniform and to identify causes more accurately; and (8) the proposed Advisory Committee study the present delegation of authority to the Association of American Railroads' Bureau of Explosives "in certain areas of the Transportation of Explosives and Other Dangerous Articles Act."

Railroad Personnel

● LOUISVILLE & NASHVILLE: **James I. Adams,** general superintendent communications and signals, appointed chief engineer.

● NORFOLK & WESTERN: **S. W. Miller,** engineer of contracts, signals and communications, has retired. Mr. Miller was born in Bucyrus, Ohio, July 7, 1904. He graduated from Case Institute of Technology with a bachelor of science degree in electrical engineering in 1926. He joined the former Pennsylvania as a signalman in 1927 and advanced to signal inspector. In 1935, he transferred into communications work and was advanced to telephone and telegraph inspector, in 1946. In 1948, he joined the former Nickel Plate Road as superintendent of communications. Following merger with the N&W in 1964, Mr. Miller was appointed regional engineer, signals and communications at Cleveland. In 1966, he was appointed engineer of contracts, signals and communications with headquarters at Roanoke. He was chairman of the Communications and Signal Section AAR in 1962.

● PENN CENTRAL: **Joseph J. Eash,** chief engineer, Pittsburgh & Lake Erie, appointed chief engineer communications and signals, succeeding **Kenneth M. Lockerby**, appointed director—electric traction, both headquartered at Philadelphia.

S. W. Miller
Norfolk & Western

Jack E. Rupp
Southern

Mr. Eash was born in Holsopple, Pa. on Apr. 11, 1915. He graduated from Carnegie Institute of Technology in 1944 with a BSEE degree. He joined P&LE as an electrical inspector in 1941, and a year later promoted to assistant electrical supervisor. In 1946, he was assistant office engineer, and in 1950 appointed chief signal inspector. A year later, Mr. Eash was appointed signal supervisor and in 1955 promoted to signal engineer. In 1959, he was appointed assistant chief engineer and two years later appointed engineer maintenance of way and structures. In 1963, he was promoted to chief engineer.

Mr. Lockerby was born in Norwood, N.Y. on Aug. 23, 1908. He graduated from Rensselaer Polytechnic Institute in 1929 with an EE degree. He joined PRR as a special apprentice, and in 1932 was appointed assistant foreman telegraph and signals. In 1937 he was appointed assistant supervisor telegraph and signals. Two years later he was appointed supervisor telegraph and signals. After three years in the U.S. Navy, he returned to the PRR, and in 1952 he was appointed engineer communications and signals. In 1959, he was appointed engineer signals and catenary, and in 1966 Mr. Lockerby was promoted to system engineer, communications and signals. Following merger of PRR and NYC, he was appointed director of communications and signals in 1968. He held this position at the time of his recent appointment as director—electric traction.

● SOUTHERN: **Jack E. Rupp,** former Atlanta representative, General Railway Signal Co., has been appointed chief signal and electrical engineer with headquarters at Atlanta, Ga. **J. Jerry Cartee,** draftsman, signal and electrical, has been appointed assistant signal and electrical supervisor at Atlanta, Ga. **Ralph L. Morrow,** assistant engineer, signal and electrical, appointed signal and electrical planning engineer, also at Atlanta. **Sam Sherard, Jr.,** signal and electrical supervisor, appointed signal engineer at Atlanta. **Robert Harp, Jr.,** electrical engineer, appointed signal and electrical systems engineer, Atlanta.

● UNION PACIFIC: **Emil A. Krause,** signal engineer at Omaha, Neb. appointed general signal engineer succeeding **Harold C. Stratton,** retired. **Duke L. Memmott,** assistant signal engineer appointed signal engineer succeeding Mr. Krause.

Mr. Stratton was born in Bellingham, Wash. on Apr. 12, 1904. He joined the signal department in 1921 as an assistant signalman. Two years later he was appointed signal foreman. In 1941, he was appointed assistant signal supervisor, and a year later promoted to general foreman CTC construction. Mr. Stratton was appointed assistant signal engineer—construction in 1950 and in Feb. 1957 promoted to assistant general signal engineer. In June 1957, he was promoted to general signal engineer.

Supply Trade Personnel

● SIGNAL & COMMUNICATIONS division of Westinghouse Air Brake Co.: **Alex Wilson,** supervisor engineer—terminal control, appointed senior marketing engineer, railway and industrial sales. He will be responsible for the marketing of terminal controls and associated products. He joined the S&C division of WABCO in 1940 as a circuit draftsman, and held various engineering assignments.

Richard A. Mather appointed marketing engineer—railway and industrial sales. He will be responsible for the marketing of highway grade crossing systems and associated products. Mr. Mather began his signal career in 1954 as a signal helper on the Milwaukee Road. Later he was an assistant engineer, signal & electrical, Belt Railway of Chicago. His most recent position prior to joining WABCO was as chief engineer signals and communications, Western Cullen division, Federal Sign & Signal Corp.

● OKONITE CO.: **Alex C. Dean, Jr.,** sales representative, Wire and Cable Div., appointed district manager at Dallas, Tex. He succeeds **Otis W. Herring,** appointed manager of Dallas Customer Service Center. **Charles E. Webb, Jr.,** appointed sales representative at Charlotte N.C. Headquarters for the eastern sales region will be located at the Avenue Building, 4500 Euclid Ave., Cleveland, Ohio.

Joseph J. Eash
Penn Central

Kenneth M. Lockerby
Penn Central

Harold C. Stratton
Union Pacific

Emil A. Krause
Union Pacific

Alex Wilson
S&C Div. Wabco

Richard A. Mather
S&C Div., Wabco

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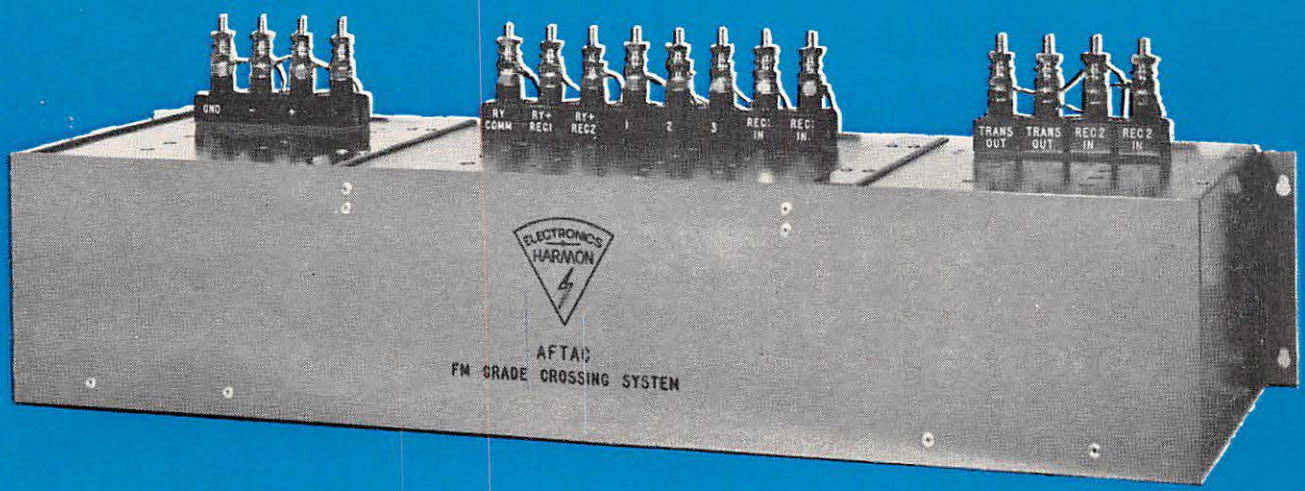

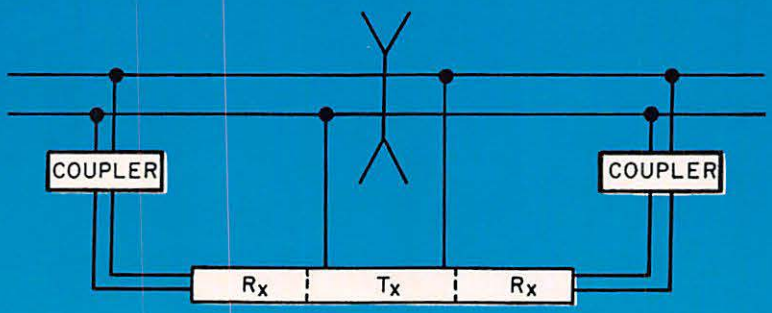

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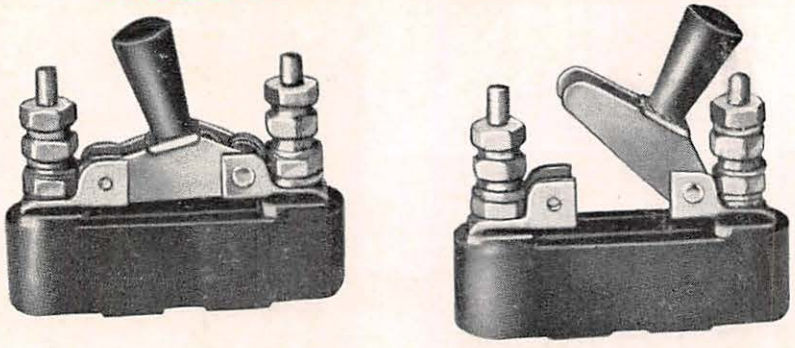

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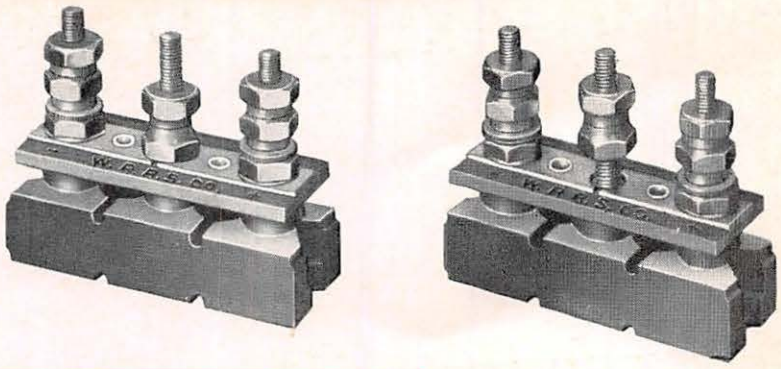

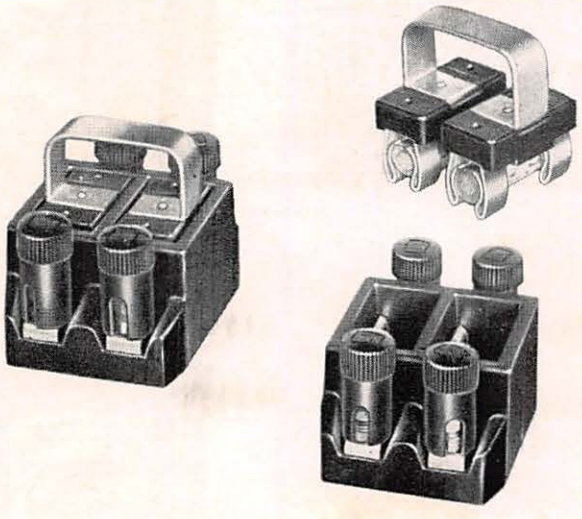

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